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# Harmony and Disorder in the Canadian Environment

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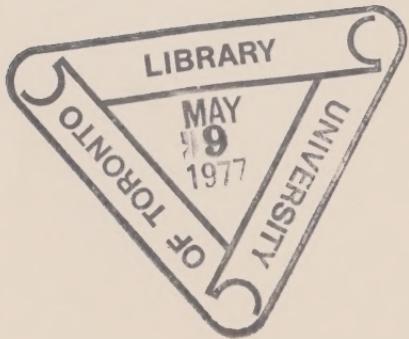
Pierre Dansereau

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Pierre Dansereau  
Research Programme Director at the  
Centre de Recherche en Sciences de l'Environnement (CERSE)  
of the Université du Québec à Montréal  
and  
Vice-Chairman of the  
Canadian Environmental Council (1972-1975)

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## Preface

The present report is very much of a personal document and does not necessarily represent the unanimous thinking of the members of the Canadian Environmental Advisory Council. It may well be strongly tainted with my own opinions and prejudices, for which I offer no apology inasmuch as this is almost inescapable if a statement is to be made that has a fairly readable coherence.

On the other hand, I can say with some confidence that all of the problems which are evoked in this report have been set before the CEAC at some time in the first three years of its existence and variously discussed. It is already apparent from the *Annual Review 1973-1974* in which issues have been dealt with more specifically by the Council. It is these very issues that are given considerable prominence in the following pages. Part B of the *Annual Review* contains a much-condensed account of the present essay.

Whereas I must bear sole responsibility for the statements made herein, I am happy to share whatever credit is offered with my colleagues without whom I could scarcely have had awareness and knowledge on so many situations prevailing throughout the breadth of Canada.

Dr. E. F. Roots and Dr. J. Keith Fraser have kindly read and annotated an earlier version and helped me to improve its contents. To them, and also to Mr. Guy Legault, to Dr. J. P. Nowlan and Dr. Ian McTaggart-Cowan, I am much indebted.

I owe a great deal to Dr. R. R. Logie, the first Secretary of the CEAC, whose quiet urgency propelled so many problems to our attention.

The illustrations were drawn by Pierre Dansereau, Roberto Teran and Robert Downing. Virginia Weadock, my assistant these many years, typed the several versions and gave much editorial and bibliographic help.

The appended bibliography by no means covers the entire field, but it will serve to support some of the statements made all too briefly or elliptically and to offer further reading material.

## Notes

An effort is made, in the presentation of this text, to spotlight certain features by using background colours wherever an enumeration is offered.

Yellow is for questions or issues

Blue is for principles

Red is for crises

Green is for research

Purple is for solutions and resolutions

I would also like to draw attention to my constant use of roman numerals (I to VI) to recall the trophic levels that appear in Figure 2 and in several of the tables. The leitmotiv of cycling order is essential to my purpose, inasmuch as this report considers technical, economic, social or political relationships in the light of their environmental impact.

Likewise, the capital letters A, B, C, D are used throughout in reference to the four principal land uses which I have defined in Chapter 4: wild, rural, industrial, urban.

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# Chapter 1. Ecology, Environment, Management

It is taken for granted by many of my colleagues that ecologists are in a position of strength wherever use and abuse of the environment are being considered. Such colleagues have sprung, as I have, from the training ground of the biological sciences and they stake a large claim to occupy the centre of the environmental sciences, inasmuch as the whole conceptual substratum of ecology has been built upon the careful study of plant and animal relationships to their surroundings, organic and inorganic.

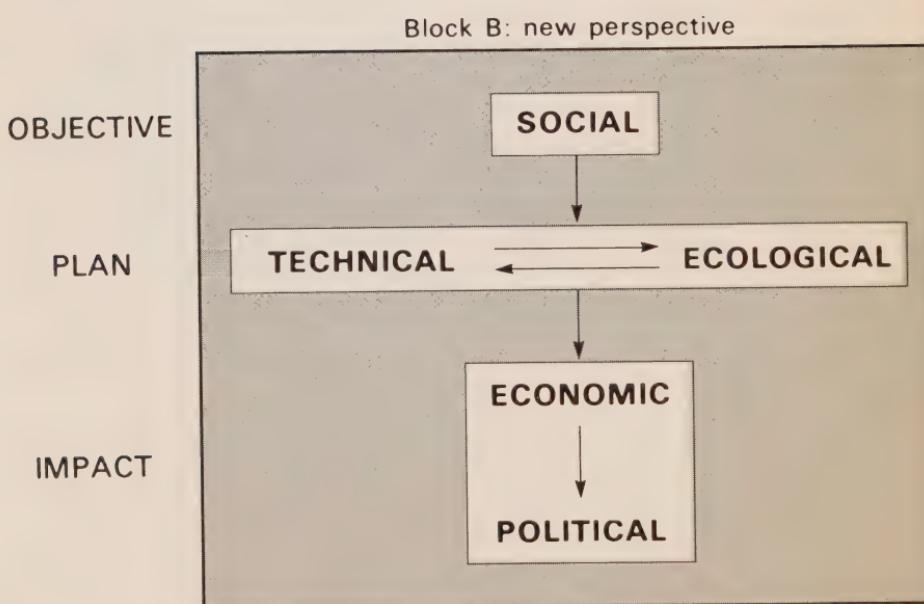
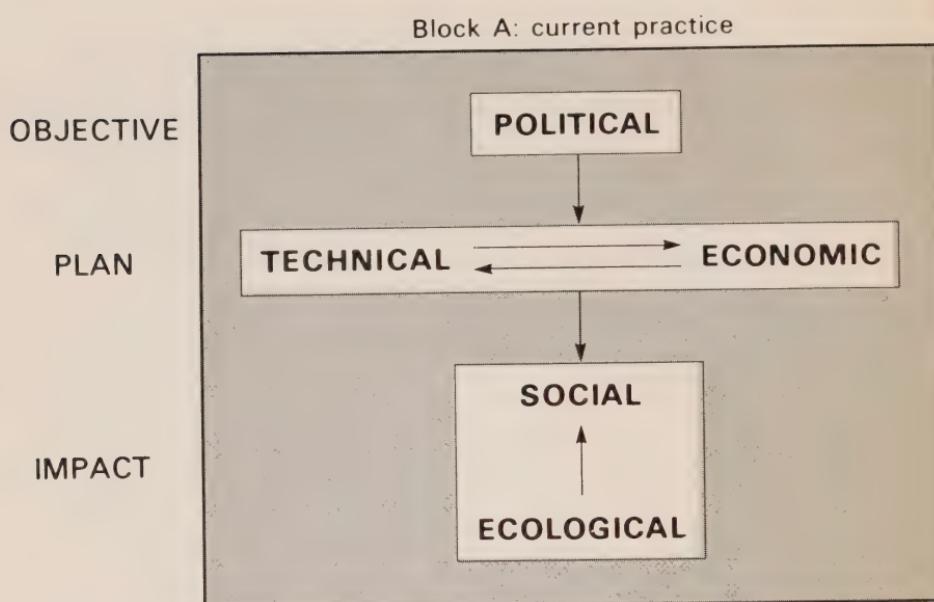
## The Background of Environmental Science

The historical pathways of the natural and the social sciences (or should I say: the sciences of man?) have repeatedly converged and diverged. The great heresy of the mid-19th century was responsible for the sundering that led to the “two cultures” (Snow 1959). This widespread schizophrenia fostered various manifestations of contempt on the part of “scientists” for the work of “humanists” and to some invidious imitations of “scientific” methodology by social scientists and has sorely marked the disciplines themselves.

Disregarding the sly digs of the more defensive or apologetic partisans of science versus the humanities, one can read the symptoms of this withdrawal in Nils Bohr’s (1963) plea for an end to ambiguity, whereas Jean Rostand (1962) and James Watson (1968) will not deprive themselves (or others) of the unreduced, irrational surge that carries both motivation and discovery. If the “medium is the message” (McLuhan 1964), it will also be argued that the “way is the end.” Maybe Boguslaw’s (1965) taxonomy of approaches to system design provides a good map of the multidirectional convergence of the mechanical and the intuitive student of environment. The claims of nuclear physics and molecular biology to a strictly reasoned and open-eyed conspectus cannot well be extended to perception of urban landscape, when indeed, as Watson (1968) has so beautifully demonstrated, experimental science itself so profitably travels the roads of intuition. The wholeness of involvement may not readily be sacrificed, nor the completeness of the act of which Stapledon (1971) writes.

Ecology-environment-management form a triptych which is the proper background of environmental science, and which, in turn, must apply itself to assessment practices. It must be the purpose of an overview of the present state of environment in Canada to consider the prevalent relay of decisional tactics in terms of objectives, plans and impacts in order to detect malfunctions, if any, and to suggest a different procedure (Figure 1). It is

*Figure 1. Objective, plan, impact and the concatenation of decision-making criteria in the present practice and in a future-oriented policy.*



then necessary to refer to the political and social intentions that justify a policy. It will subsequently be useful to touch upon the forces of environmental control and to locate the points of crisis in Canada at this time.

It is hardly surprising that Canada has no population policy (and therefore a poorly-defined immigration strategy) and no environmental policy either. It is no doubt the main role of the Canadian Environmental Advisory Council to elaborate such a policy, to explicate it at several levels, to call for responses on the part of all segments of the population, and to offer a running commentary on the way-things-are and a set of quick-fire recommendations on what should be done.

Block A of Figure 1 illustrates the present strategy of decision-making where major undertakings are involved, such as dam-building, airport construction, urban expansion, etc. The earliest decision is of a political nature and may well be based on a long-sighted policy of development and progress but is all too often inspired by short-range expediency. The planning is initiated on the basis of technical feasibility (more or less tested) and on economic yield (more or less hypothetical). The impacts are basically of two kinds. The social consequences have already been assumed (at the political level) to be positive at least so far as significantly powerful segments of the population (general, not local) are concerned. The ecological consequences are, by and large, an afterthought.

An alternative sequence of relayed decisions is offered in Block B of Figure 1 where the initial point is social, whereas the planning is primarily eco-technical and the impacts are economic and political.

It is never safe to take such formulations literally, for they lead to the compartmentalized thinking that is most inimical to the holistic point of view. In fact, we do not really separate these categories in our perception of environmental situations, and the triggering of decision-making obeys the combined weight of conclusions reached in all of the six major fields represented in this sketch. This should not imply that the sequence and the *ponderation* are indifferent, and it is the purpose of a model of this kind to devise one pathway (Block B, Figure 1) which is more likely to fit environmental considerations into the decision process and to allow them their proper weight and timing. Throughout the present essay this will be emphasized.

## **The Meaning of Sharing, Participation, Diversity**

The placement of social facts and values at the origin of such a process is intended to gear the concatenated operations to the actual or potential (or only possible!) goals of the society which is involved. In other words, an *environmental ethic* is no sugar-coating or rationalization; it is the very *moving force* at the point of departure as well as at the point of arrival of the whole process.

The Canadian Environmental Advisory Council has given this basic element of the problematique full recognition in preparing a report on an environmental ethic. (Morse 1975). This document need not be paraphrased here, except to re-emphasize the basic reality of a given society's capacity to identify damages and costs and its trade-offs for the attainment of its true priorities. That such priorities are not consciously perceived, but are indeed maintained by the hammering effect of subliminal persuasion, is also our concern. The revelation of what is, the enlightenment on what the remaining choices are, in the long run, are very much the concern of the Canadian Environmental Advisory Council, and they need to be clearly defined and to be constantly spotlighted as background to assessments of Canada's environmental potential and to recommendations concerning management.

As the Morse report (1975) amply testifies, the detection of an implicit environmental ethic in Canada is a nearly impossible task. It is, of course, tantamount to the formulation of a social, and possibly a religious, creed that is applicable both to the people's and to the individual's sense of stewardship.

The necessity of meeting the challenge of uncontrolled growth, not merely by a more adequate technology and a planning that is more sparing, leads to the resetting of national and international goals. This, in turn, can only be based on an environmental ethic that will achieve a very broad consensus. If the issues can be expressed in acceptable moral terms, the corrected behaviour which they imply will require a tension (a morale) of which we may or may not be capable.

Can we say, for instance, that *every man shall strive to maintain harmony within and between all the ecosystems upon which he has influence, thereby ensuring the continuance of diversity and the availability of choice, and also minimizing irreversible changes?*

Such a formulation has the advantage of being positive. However, it is decidedly too general and needs to be spelled out in ecological and economic terms before it can be implemented in the form of regulations and, eventually, of legislation.

The Stockholm Conference, the two sessions of the United

Nations Environment Programme, and the several public declarations by its director general, our compatriot Maurice Strong, as well as the recent speech of the Prime Minister of Canada, Pierre-Elliott Trudeau in 1974 at Duke University have brought two main objectives before the people.

The first is the ecological fact of the physical impossibility of continued exploitation-production-consumption at the present rate.

The second is the very need for an explicit environmental ethic as a basis for national and international agreements on the limitations of resource tapping.

We no longer live in a time when social and economic forces can be allowed free sway. Nor can we be content with rules and regulations that merely contain the unintended damage that is done to our lives and our environment by the outbursts of demographic and economic growth. A more cogently reasoned plan is urgently needed for the tapping of our national and international resources, for the distribution of our products, and for participation in the decisions that influence both tapping and distribution.

The human predicament, at this time, reads very ominously: progress of the world economy within the channels in which it is engaged leads to disaster (Ward and Dubos 1972, Peccei 1973a and b, Mishan 1967). The forging of new channels requires a drastic shift in values. Those who are empowered to redraw the channels are possibly the least amenable to a resetting of goals. If I try to spell this out, I find that, on a world scale, the efforts to limit population growth show little sign of success, except where they are possibly least needed. On the other hand, no realistic attempts seem to be made anywhere to limit excessive consumption, except where poverty imposes its own forms of frustrated abstinence. *It is therefore not surprising that no beginning is being made to curb production itself, whereas it is straining the reserve of resources already.*

It has become a truism to say that the rich nations are getting richer, the poor nations poorer (Ward 1961). In fact, the nearly universal desire for unlimited and uncontrolled growth is shared by the rich and the poor. The ransom of a deteriorating quality of life, long paid by the hopefully rising classes, is now levied upon the rich as well. The pervasiveness of pollution and the growing disruption of services (air transport, mail delivery, credit systems, domestic and medical care, marketing, building, food distribution) are on the point of cancelling out the relief from drudgery that

sophisticated technology was intended to assure. Runaway affluence is a bore that has killed many hopes, fostered rising criminality and the corresponding refusal of social solidarity.

"Copping out" and other forms of evasion provide no answer; they simply deprive the social ecosystems of much-needed energy and imagination. It is not enough to withdraw or to condemn. At all events, pessimism may provide an excellent drive for analysis of our pathological state, but only optimism can reach out to a solution.

We have long had with us two kinds of optimism: the technological and the social. Scientists no less than others have been divided in their hopes for the "shape of things to come". Even in these days of visibly irreversible damage to the environment, one still hears an expression of confidence in the powers of undiscovered technology to keep the human economy in balance. It is hard to convince these true believers that the present predicament is not merely the effect of a larger catastrophe, but the result of newly unleashed forces (Peccei 1973a, b).

The second kind of optimism places its faith in man's capacity to contain himself and forego the full application of his power to make the environment yield. A preference for the optimum rather than the maximum, for renewal rather than exploitation, requires some form of self-denial or austerity. I have often advocated a *joyous austerity* (Dansereau 1973b) as the key to a wise utilization of our resources and a just distribution of their products. Maybe this would also induce a greater satisfaction in our work, a keen sense of relevance to our world.

But, are we ready for utopia? And is it true that we must choose between utopia and anarchy? Is it true that if we do not reset our goals we can barely hope to survive? Even with computers to the rescue, I do not really believe in making a final pronouncement on the future of man, or yet on the manner of his death and extinction. One man or one group of men has a limited grasp of the whole reality of the present time. We can only pretend to achieve a tentative equation of population-resources-production-happiness that fairly accounts for our past, present, and future position on this, our only, planet (Nash 1972).

I may as well indicate my personal acceptance of the Club of Rome's statement (Meadows *et al.* 1972) so convincingly brought up to date by Peccei (1973a, b) and by Mesarovic and Pestel (1974) although I am no "future shocker", and refuse to join the doomsday patrol. Miguel de Unamuno (1958) said that he was "only a poet, nothing less than a poet". It is my belief that poet-

scientists, first cousins to Don Miguel, must also be heard at this time, for their perceptions can be displayed in contrast to those of the prophets of disaster.

Intellectual courage and dauntless imagination are the keys to Canada's vision and accomplishment in the face of the contradictory forces that animate our society. F. Scott Fitzgerald put this dilemma in the following terms: "The test of a first-rate intelligence is the ability to hold two opposed ideas in the mind at the same time and still retain the ability to function. One should, for example, be able to see that things are hopeless and yet be determined to make them otherwise . . . I must also hold in balance the sense of the futility of effort and the sense of the necessity of struggle; the conviction of the inevitability of failure and still the determination to 'succeed'." And Albert Camus said: "A man does not show his greatness by being at one extremity, but rather by touching both at once" (quoted in a recent issue of the *Times Literary Supplement*).

These masters of ambiguity (who managed their own lives all too disastrously) are better guides than the fanatics who confront us with absolute choices. We must work on all fronts: demographic limitation, technological improvement, equitable sharing and rigorous management.

Our faith in ourselves, therefore, is bound to aim, as it always has, beyond our capacity of achievement. *The value of a goal does not lie in its accessibility but in the magnetic attraction of the direction which it requires.* The voyage, not the point of arrival, is essential. I therefore submit that joyous austerity does provide a focus for our thinking about man and resources, and does indicate a route for us to travel.

We need hardly deceive ourselves about the proximate or ultimate goodness of men in order to endorse, as a working hypothesis, the possibility of the approaching limits of growth and the urgency of doing something about it.

Let me first define a little further what I mean by joyous austerity and then proceed to the search of some intermediate goals that are really within our reach.

A society more truly conscious than ours of itself and of its environment shows a sort of deference towards the objects that make up that environment and indeed to those that it has produced. Thus the Japanese reverence for stones, the Arab delight in water, the English feeling for trees, the Indian respect for cattle, the German care for musical instruments, the French pride in books, all point to a meaningful identification with a

resource or a product whose place is somehow privileged in the individual's daily life. Many sacrifices will be made toward the preservation, the enhancement, the wise use thereof. An old Zen proverb says: "To a man who knows nothing, mountains are mountains, waters are waters and trees are trees. But when he has studied and knows a little, mountains are no longer mountains, waters no longer waters and trees no longer trees. But when he has thoroughly understood, mountains are once again mountains, waters are waters and trees are trees." Crossing the thresholds of these three levels of perception is an exercise in which all too many of us do not indulge. For most of us, the traditional artisan stands out as the prototype of this kind of reflection and dedication, which has been celebrated in poems, prose and music for centuries. The swamping effect of modern technology, because of the historical accident of planned obsolescence, has tended to dull our faculty of appreciation. Acquisitiveness and spending (especially if conspicuous) are its substitutes.

The kind of austerity which I think we shall have to practice before long resides in a recognition of the value and so very often the beauty, of water, paper, plants, vegetables, animals (wild or domestic), hardware, houses, books and many other familiar objects. Scientific inquiry into their origin, provenance, texture and uses is rather easy since the educational process and the various communications media make information so readily accessible. Not for all of us, but for many, these objective criteria lend considerable support to an aesthetic valuation and to a proprietorial feeling. For others, the pathway is reversed: from art to science. For all, these "conversation pieces" provide a happy pretext and a true focus for human communication.

Whether inspired by puritanism or by epicureanism, by dedication or self-interest, austerity is purposeful, exacting and requires vigilance (identification of issues) and positive action. This is where intermediate goals take on their full significance: thrift, sobriety and restraint, are not their own reward.

"Stress without distress" in the words of Hans Selye (1974) can only be achieved by a polarization of an individual's energy towards goals that lie beyond him. It strikes me that the following areas of everyday life lend themselves to habit-forming practice that may well prepare us for the more dramatic constraints that are to come. True to my calling as an ecologist, I will list them in the order in which they appear in an ecosystem, up from mineral, to biological, to human resources (see Figure 2).

- a) **Water** runs all too freely in our household, and sometimes all too lavishly in our gardens. Taxes are not generally proportional to amounts actually used. Where meters are installed, more care is exercised.
- b) **Heat**, especially in Canada and the United States, in the winter-time, is shockingly wasted by existing systems of central heating and can very well be cut down considerably.
- c) **Glass** and **metal** containers are ruthlessly disposed of instead of being re-used and recycled.
- d) **Vegetables** and **meat** are only partially used: peels, rinds, stems, skin, fat, bones, etc., are rejected instead of being used in a number of simple recipes or recycled.
- e) **Paper** is thrown away by the ton instead of being re-used (especially wrapping paper and envelopes) or recycled.
- f) **Automobiles**, other vehicles, and also all kinds of **hardware** are discarded and replaced long before their usefulness has been exhausted.
- g) **Books** and periodicals already perused are not sent to libraries, hospitals or schools where they could be shared by many people.

This foreshortened enumeration evokes the average household in Canada. The kind of vigilance which is called for in terminating the misuse of all these goods is unthinkable in many families. Watching the faucet, not putting more on your plate than you are likely to eat, making do with left-overs, canning and preserving, looking for new recipes<sup>1</sup>, segregating paper, metal, and glass from domestic garbage, carrying materials to redistribution or recycling agencies, all call for collaboration within the household unit, a more explicit sharing of responsibility and the acceptance of a few additional chores.

<sup>1</sup>It is no accident that the finest cooking in the world (the French and the Chinese) has been devised through centuries of vigilant thrift.

Do Canadians, in 1975, lack the fibre and the fortitude to freely undertake something of this kind?

Is it unrealistic, reaching outside of the family circle, to further suggest the reform of the public transportation system? To contemplate the interdiction of parking private cars from 7:00 a.m. to 7:00 p.m. in the centre of the cities? To eventually limit ownership of cars to one per household unit?

I hardly dare mention in the same breath a work calendar reform that would make fuller use of offices, stores, classrooms, theatres, churches, subways, warehouses, etc. And yet, if our society eventually puts an end to subsidized non-productivity, will this not be necessary?

Taken individually, all of these restraints may not seem very grave. If they should engage the goodwill of a large segment of the population, the drain on our water-table, on our mines, on our forests and farms, and of course on our imports, could be substantially lessened. Could not human bonds be strengthened and mental health be favoured, as indeed they were (by these very practices) during that highly visible crisis that was the Second World War?

I do not doubt that the present environmental crisis is as serious as the Second World War, although I am bound to recognize that it is hardly possible to render its urgency nearly so sensible to all concerned.

It is with such visibility that environmental scientists are concerned. Marshalling the body of facts that is indispensable to our understanding of environment, in Canada and elsewhere, is our primary task. Fitting this factual situation to its social, economic, and political context is also our role. Devising solutions, finally, cannot be left to the politicians. As I am suggesting in Block B of Figure 1, the present decision sequence must be challenged: political decisions must be contested and economic pressures opposed by us whenever they aim at those partial solutions that merely create new problems. A feeling for the wholeness of the environment, for the coherence of ecosystems, is now emerging, and there is real hope that the prevailing adhockery that has so often defeated itself will be replaced by authentic planning and that a new design for living will emerge.

The ecologist perceives this design in terms of *diversity* and *opportunity*. It is one of the outstanding laws of environmental science that a heterogeneous environment offers development and fulfillment to different agents, whether they be plants, animals or men. Canada is fortunate in having a great variety of landscape

and, at various times in its relatively short history, they have given rise, through the ingenuity of various populations, to different ways-of-life, complete with shelter, food, folklore and culture. *It should be no part or parcel of "modern living" to abolish the past and to homogenize the present.* The conservation of earlier and other ways-of-life should be no sentimental enterprise of museum building. Whereas we make a large political display of recognizing the right of Inuit and Indians to live either as their ancestors did or to live as we do, on the other hand we give our supposedly mobile Canadian population very little option to live in wild or rural environments, nor have we made our rumbling cities fit to live in. *Keeping the successful adaptations of the past alive to enrich the fabric of present Canadian life, diversify its productivity and its options, and improve the quality of life is no backward step.* It may be one of the preferred responses of the 21st century to the post-industrial challenge.

The trend of this argument is that justice, peace, order, efficiency, and survival itself (whether seen in that sequence or in reverse order) are conditioned by a change in attitude, a very important shift in the way-of-life of the affluent nations, including Canada.

The torment of our times is not a struggle with the God of the Middle Ages, nor the introspective romanticism of the 19th century, nor yet the dedication to material growth of the first half of this century. Although our alienation feeds upon denial of all three of these attitudes, it is compounded of a dedication that resembles medieval mysticism, of a latent mistrust of self that mirrors puritanism, and of an inverted hope for a better material world that mocks progressive strivings. The loss of motivation that so visibly afflicts many members of the Canadian community is partly the result of a bewildering shift in the social roles of the individual and of the professional group in a pre-revolutionary period. For I believe we are at the beginning, not at the end, of a major turnover of social values.

Because of an uneasy feeling that common goals have to be reset, our political, economic, social and religious institutions have undertaken the task of modifying their structures, essentially in the hope of improving what they were already doing. Such a preoccupation with continuity, at its best, is likely to stop the generation gap; at its worst, it paralyzes the historical process itself by excluding new functions that cannot be fulfilled by mere structural reform.

But what are the trends of our society at this time? What profound changes, if any, lie beyond the fashionable slogans of reformers and critics? What clues are being given to those who manipulate the levers of power? What responsibility are universities, news media, government departments and political parties assuming in this respect? Do they try to give the people what they want? Are new subjects included in curriculum and propaganda, and learning techniques devised the better to respond to new-found requirements? *Shall we support the claims of a sophisticated illiteracy? Of a hallucinated anarchy? Of an inverted aestheticism?*

What are these major movements in our society that demand involvement, and that presumably also cry for the kind of leadership which must come from a dialogue of the universities, the government and the people?

I wish I were able to answer this question in a language more direct than Marcuse's (1968) and less apocalyptic than Teilhard de Chardin's (1959), although I acknowledge a debt to both of them. Contemporary man's revolt against the established political, economic and religious orders reaches very deep and suggests the emergence of a new assumption of responsibility. The traditional Christian view of personal salvation is being shifted to one of solidarity that is less compatible with a socially and economically competitive society than the churches have so far allowed. The renewal also with a more naturalistic concept of man has challenged the tenets of personal morality to the point of rewriting whole chapters of the civil and criminal codes. *Sharing, participation and diversity* are the key words, something more than a re-statement of liberty, equality and fraternity.

## Chapter 2. The Requirements of Environmental Planning

For several years to come it will be safe enough to say that the hard core of environmental science is ecology. *The methods and principles of ecology are derived from the study of plant and animal interdependence and influence upon their surroundings, and they provide whatever consistency we have in this enlarging field of research.* Such reliance upon biological networks and cybernetics is not likely to subside even when new models are cast as a result of a sophisticated systems approach.

We must seek new ways of assembling population-resource data in our quest for conceptual breakthroughs. It does seem most likely that environmental science will reach higher levels of integration through the sheer intellectual effort of reflection upon generalized patterns of adaptation, gregariousness, efficiency and productivity. Enough converging energy is now concentrated on this task to raise great hopes for an illumination that may well amount to a major discovery. Now that the challenge for survival of our species has been faced, not only in speculative isolation by the philosopher and the physicist but by the engineer and the economist as well, in conversation with the biologist and the geographer, it can reasonably be assumed that a brand-new matrix is in the making.

Much as we may trust, however, in the capacity of the human mind to manipulate itself as well as its multifarious clinking and blinking extensions, there remains a major role to be played by the whole self immersed in the real environment.

**Institutional Responsibility**  
We need educated bodies as much as we need sophisticated minds if we are going to identify the relevant parameters of environmental problems and pose answerable questions.

We need physical exposure to the stream, the bog, the forest, the rookery, the farm and the slum. The current of disfavour which only yesterday almost brought to a standstill those programmes of academic study that centered in the field has recently been reversed. The philosophers and the economists themselves are no longer content with a harvest of symbols in the manner of Jean-Jacques Rousseau (although he was a more sensual man than Karl Marx): they now try to put themselves in the presence of real stones and birds and trees. The ever-increasing facility of international exchange has made us all witnesses to a greater variety of environmental perception and of its translation into private and public works. Thus, the opening vistas of Scandinavian and Japanese traditional achievements offer the modern

environmentalist a thrill of recognition and a motif for implementation.

Is it wishful thinking to consider the possible deflection of sensibility in Canada towards our own heritage? At Expo 67, visitors from all over the world and Canadians from all over Canada were invited to identify themselves with the achievements of Huron chieftains, French explorers and British administrators, and with poets, scientists and artists born in Canada. The un-learning of our history is heavy with goodwill but too light in emotional content for an Ontarian to think of Champlain as a forebear or a Québécois of Alexander Graham Bell as a benevolent uncle. For many Canadians the grand circuit of human solidarity in the face of the environmental crisis leads back to the very real and powerful means at our disposal in this country to solve our problems.

The society that binds us together is conveying messages that are especially aimed at the environmentalists. If we are indeed attuned to relatedness, we cannot fail to grasp the meaning of revolt against excessive production and consumption. As scientists, we are bound to stand in defence of technology (Medawar 1969), but we cannot hold this position if we are unable to imagine alternatives to its present inhuman misuse. It is up to us to create a happier hardware world where industry will work for people, not for money, where jewellers will return to their vocation as artists and not as providers of status symbols and good investments. I am tempted to go another step and to say that environmentalists can help tear down the symbols and restore our people to physical and spiritual reality. Maybe long hair and public nakedness will soon be acts of joy and participation and not signs of alienation and refusal of brotherhood.

Lest I appear to indulge in unrealistic forecasting and in future shocking, let me add that much of what I have just written derives from whatever wisdom I may have gleaned in the past ten years or so, as a witness, sometimes at close range, of the efforts made in North America to carve a niche for environmental science in the academic world. In speaking of harmony I am thinking of the delicate balance that allows its full weight to each of the main components: physical investigation, calculation, thinking, speculation, planning and implementation. And, above all, a lively conversation between the natural sciences and the sciences of man. The complete cyclic act is a rare thing, and the universities have all too often discouraged it by providing no link between mathematics and music, biology and engineering, and medicine

and social work. The jealous monopolies of departments are hard to break and the lasting and necessary tension between specialists and generalists has to be resolved all over again, year after year. The rewards of teamwork are less tangible than those of individual achievements. If new questions can be posed by interdisciplinary groups, there are real chances of obtaining workable solutions. And yet the means of funding and housing interdisciplinary research are generally out of reach.

The peace of the campus and the noise of the city used to be antagonistic. I do not think we can look back proudly upon such a situation. If it is now the ferment of the campus that is leavening the fabric of the city, I would like to believe that the academic community is only resuming its truest function. Whereas I have often been shocked by the irrelevance of a particular university to the community that supported it, I can hardly accept that there is only one manner in which the university and the community can interact. There are, on the contrary, many ways in which the portals, no matter how heavy, can swing in and out. It strikes me that the acknowledgement of the environmental crisis has itself oiled the hinges and activated the traffic. The CEAC, a congregation of university, business, and public-service personnel, shows good evidence of this, as do the Science Council and other government-sponsored (and non-decisional) bodies.

If the function of the environmentalist is not merely to analyze but to participate in planning; if he must learn by calculating and pondering, he cannot stick to the drawing board but he must tread every inch of the field. Learning by doing is essential at all levels, and all the way up from pragmatic solutions to an ever-sharper but still shifting definition of the scope of environmental science itself.

The universities, therefore, must remain as the principal providers of knowledge, the deepest well of expert consultation, and the originators of new skills. But they cannot possibly operate as independently as they have generally done in the past. Disregarding the preoccupation with "structuritis," it can be claimed that, within the universities, a new environmental science with man at the centre is developing and promises:

- a) to achieve a sharper focus in this generation;
- b) to serve as a matrix for a new level of unity of knowledge;
- c) to evolve empirically through application of large- and small-scale socio-economic projects;
- d) to respond to a broadening and a diversification of perception and consciousness;
- e) to provide the indispensable background to planning.

Since federal agencies are responsible for a more substantial share of grants and contracts for research, the following undertakings more or less fall under its responsibility:

- a) regional tests of environmental perception;
- b) development of geographical psychology patterns;
- c) consultation on priorities and areas of possible trade-offs;
- d) experiments on resource sharing and resource economy.

In some way, therefore, new theory, new knowledge and new skill are in search of a means of integration upon which the issues can be projected.

Damming, road-building, city planning and other public works in Canada do not offer a shining example of either aesthetic achievement or harmonious development, or even economic wisdom. Respect for the value of rock, soil, plant, animal or man is not conspicuous in our highway network which does not pay the attention to geomorphology, to drainage or to soil that is so evident in Scandinavia. Many roads actually spoil the picturesqueness which they are supposed to make accessible. Our waterways are deprived of their productivity as well as of their amenity. Our dams have annihilated large portions of a reputedly inexhaustible store of timber, fish and wildlife. Our cities have grown like Topsy and, at this late hour of planning, are hard in the

grip of speculators and heavily burdened with pollution too costly to be corrected. Our seaports and airports are as soiled and noisy as any in the world.

But we are doing something about it. Industrial location and highway openings are no longer so haphazard as they once were; there is a hue and cry on the part of many conservation groups whenever an airport or a hydroelectric development is announced; there is a general revulsion against indiscriminate "progressive" town renewal and highway development. In all of the crises triggered by these projects, all of them ostensibly geared to continued productivity of our society, and to the increase of the GNP, the essential question is: "What about man?" And more immediately: "What about us?" What about those whose habitat is being altered? Must the prosperity of the nation be at the expense of the health and happiness of those who dwell in the lee of the highway, the dam, the asbestos plant, the polluted riverbank? Will the Indians of James Bay be swept from the territory so that Montréal (and New York!) can have more electric power?

Interdisciplinary teams have begun to emerge in a variety of ways and in a number of places. The mutual distrust between the *humanists* and the *scientists* (or is it between the *hard* and the *soft*?) is still very much in evidence and no less on university campuses than elsewhere. But pioneers from both groups have provided the props for common platforms and are engaged in something more than an exchange of views. As a participant in one of these major experiments (Dansereau 1971a, 1972a, b, 1976), I have been at great pains to say that we are still very far from having designed a "best way" of making an environmental assessment and of devising a way of ecologists to participate in planning. It can well be argued that the great diversity of environments will always resist anything like uniform methodology and strategy. Bypassing the psychological pitfalls of team work, let it be remembered, is a major part of experimental design!

Most of what has been outlined above may well argue in favour of a more thorough and better oriented *analysis*. Indeed, I should think that, ecological tools and environmental-science methodology provide the best means towards *understanding environment*. Ecological analysis, followed by integration of data and synthesis of results will project a true picture of a given mosaic of ecosystems, at a given place and time, but does it provide a plan? This is one of the underlying issues of environ-

mental assessments which have been dealt with by the Canadian Environmental Advisory Council (1974). Again, this report is very explicit and very concrete and I shall not paraphrase it.

Referring back to Figure 1, it is clear that whatever message the environmentalists hope to convey will have very little effect if the decision-relays remain as they are in Block A. On the contrary, if ecological input is moved up (as in Block B), the environmentalist becomes a full-time partner in the planning process, and eco-planning is recognized as being crucial.

How much of this do we have in Canada at this time? Are competent personnel present in the private or public undertakings where a critical kind and amount of resources are involved and a critical change is likely?

One thinks, among other things, of the following areas where there are potential crises:

- a) Weather monitoring, and air modification and control;
- b) Water storage, diversion and modification (including pollution);
- c) Mines and surface borrowings;
- d) Forest clearing and exploitation;
- e) Preservation of "natural" areas;
- f) Agricultural maintenance and development (including fertilization);
- g) Animal breeding, range and pasture management;
- h) Power development (hydraulic, fuel-operated, nuclear);
- i) Communication network (including roads, airways, radio, satellites);
- j) Ports, airports, storage places (warehouses, parking lots, etc.);
- k) Industrial plants;
- l) Urban development, extension, renewal, planning;

Under each of these twelve headings, a very particular conjunction of environmental stresses needs to be detected, and their impact must be built into a plan for adequate protection, utilization, exploitation, development or transformation. For many years now, criteria have been proposed and assembled in assessment matrices of one kind or another. The complexity of landscape mosaics and of competing land uses is no deterrent to the analyst, although it may well seem bewildering to the user and to the planner.

I am afraid I cannot accept the argument that since we do not now have a methodology for *uniform environmental assessment*, we cannot know what we mean by making such an assessment compulsory (e.g., in the twelve examples mentioned above), and therefore must stop short of legislation. As I believe is amply evident in McTaggart-Cowan's report (1974), we do know which parameters are relevant in given situations, and some valid assessments have been made that do contain a sufficient input to decide:

- a) for or against the project;
- b) for the project with certain cautions;
- c) for a complete redrafting of the proposed plan.

It may be well at this stage to spell out the kind of input which is useful to a well-rounded environmental assessment. If it is to be of truly ecological inspiration and if it is to gear the information to its spatial significance, it can well be organized *in the image of the ecosystem itself*.

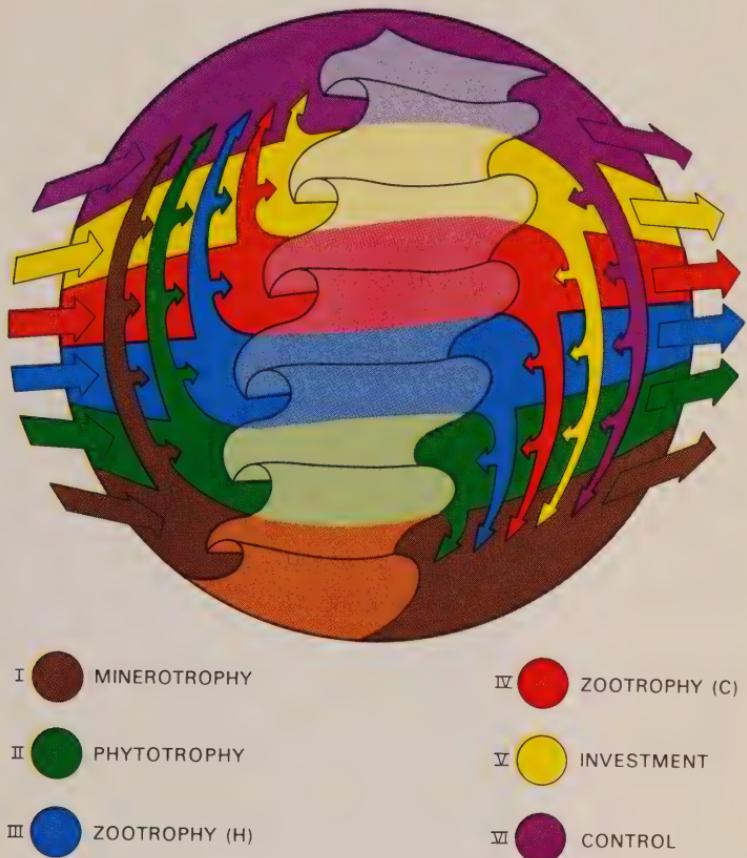
The ecosystem can be defined as: *a bounded space where the cycling of resources through one or more trophic levels is effected by more or less fixed agents utilizing mutually compatible processes simultaneously and successively, which engender products that are usable on short or long term*. My own visualization of the ecosystem, according to this definition, is shown in Figure 2. This scheme has been defined and discussed at some length in several of my publications (1971b, 1973, 1976). It need only be briefly outlined here in the interest of the correlations that will be attempted in the following pages.

The basic structure of the ecosystem, according to this model, can thus be read, level by level.

- I. **Minerotrophic** regime: mutual interactions of gases, liquids and solids yielded by parent-rock, water and atmosphere result in distribution of light, heat, energy, water, nutrients and substratum that offer support, shelter, nutrients.
- II. **Phytotrophic** regime: the tapping capacity of plant species allows a transformation of non-living particles into vegetal tissue.
- III. **Zootrophic (phytophagous)** regime: plant-consuming animals transform vegetal into animal tissue.
- IV. **Zootrophic (carnivorous)** regime: animal-consuming animals prolong the food-chain and engender further animal products.
- V. **Investment** regime: mineral, vegetal and animal products, also artifacts produced by animal or man, are variously disposed of or stored for deferred or continued use or usefulness.
- VI. **Control** regime: some agents (sometimes animals, often man) are able to manipulate a key resource (water level, bank system) so as to direct and channel virtually all of the processes of the ecosystem.

Such is the assemblage at each trophic level of the agents, processes and products animated by the energy flow that follow the arrows in Figure 2.

*Figure 2. A scheme showing a projection of the six trophic levels (and their characteristic process) of the mainstream flow of energy (central), the supply of resources (left) and the reinvestments (right), as well as imports (left) and exports (right).*



An interdisciplinary approach to the planning of a wildlife reserve, a tanker port, a hydroelectric dam, a suburban development requires the pre-emption of each of the six levels by specialists in the corresponding discipline. As an example, Table I lists, at the trophic level where it operates, the *factor* (or object) which is to be reckoned, the space or the *function* which it affects, and the nature of the *competence* which is required to deal with it. Although this is neither the place nor time to detail the difficulties and uncertainties of interdisciplinary work, it may be well to take our bearings. I venture to single out the following points of reference, as they are relevant to my own experience and since it is virtually impossible (or presumptuous?) to propose a general model.

- a) There is no such person as a good generalist who is not or has not been a good specialist.
- b) The disciplinary fields required and the relative weight of each one vary according to the project itself.
- c) The capacity to produce an over-all plan that will offer adequate opportunity for specialized knowledge to adjust depends upon the initial conception, the polyvalence of several team-workers other than the leader, and upon discipline and personality.
- d) Early awareness and participation are indispensable.
- e) Follow-up requires the continued presence of the environmentalist.
- f) A reasonable amount of confidence, or at least a great freedom of exchange of information between the sponsor and the assessing team is essential.

**Table I.** An example of gearing interdisciplinary study to the eco-systematic structure of the affected environment. The case of a large airport (Dansereau 1976). This table should be read from the bottom upwards.

Trophic level	Factor	Function	Competence	
VI Control	Recreation Culture Education Government Finance	Legislation Relocation Transfer Planning	Political science Law Economics Engineering Administration	VI VI V-VI V-VI V
V Investment	Work Habitation Construction Circulation	Regrouping Importation Substitution Succession	Geography Engineering Architecture Sociology Economics Psychology	I-VI V-VI V V V-VI VI
III-IV Zootrophic	Animals	Hazards Food Survival	Epidemiology Wildlife management Veterinary science Agronomy Animal ecology Zoology	VI III-V III-IV II-V III-IV III-IV
II Phytotrophic	Flora Vegetation	Hazards Food Substitution Succession Destruction	Design Agronomy Forestry Plant ecology Botany	VI II-V II-V II II
I Minerotrophic	Noise	Residence Work Transport	Medicine Sociology Engineering Physics	V-VI V V I
	Water	Drainage Evacuation Water level Supply	Engineering Agronomy Geography Geology	V-VI II-V I-VI I
	Rock Gravel Sand Minerals	Relief Transport Support	Economics Engineering Pedology Geology	V-VI I

Much has been written, and often in a pessimistic mood (Marsan *et al.* 1973), about interdisciplinary work. The principal paradox no doubt lies in the very motivation of the collaborators. They respond to the challenge of a goal that lies beyond their individual competence and yet is unattainable without the full impact of their disciplinary powers. On the other hand, their pride is geared to the free exercise of a specialized knowledge where they have achieved intellectual security. As Mary Douglas (1973) has put it: "all subjects grow strongest where they are most autonomous. The centre of an intellectual discipline is defined by its capacity to settle its own theoretical problems on its own terms. Around this centre the most forceful exponents find it most worthwhile to cluster. The fringes are for the fringy. Thus a centripetal force in the institutional framework of knowledge exerts a magnetism for talent, time and funds. This magnetism of the centre needs a little time to get established. Continual turbulence at the boundaries of a subject interferes with its influence. In the physical sciences, industrial and government investment in research exerts strong countervailing power, so that the boundaries are constantly being re-defined to incorporate interdisciplinary finds."

The emergence, in Canada in recent years, of several interdisciplinary teams offers exemplary testing grounds for the difficulties of facing such paradoxes. Some of our Canadian teams (e.g., cardio-vascular research involving physicians and engineers) are ivory-tower exercises, others, although involving only academics (like the International Biological Programme), have an international field base, and others still (like the James Bay hydroelectric development) are geared to engineering calculations and economic objectives.

The successes and indeed the failures (we learn only from our failures?) are notable. Yet they are not well known, in most cases because the projects are unfinished or too recent to allow evaluation.

I suggest that research along these lines is very urgent, for instance on the following points.

- a) Compilation of all existing visual and mathematical models of environmental analysis.
- b) Application of several models to a single situation for purposes of comparison.
- c) Long-term verification of the predictions made by interdisciplinary teams.
- d) Comparative case-studies of the concatenation and sequence of decision-making processes.
- e) Documented study of decision reversions in large projects.



## Chapter 3. The Forces of Environmental Control

The presence, the breadth, and the timing of environmental expertise is one thing; the articulation of knowledge, consultation, and skill with power to implement is another. Levers of decision that affect environmental management can be detected in each of the positions defined in Figure 1. Because of my preference for the concatenation in Block B, I shall follow its ordination in preference to Block A, the better to account for environmental strategy.

To put Figure 1 into Figure 2, the following line-up can be made. Decision centres are at the levels of investment (V) and of control (VI). Starting with investment: technical forces (machinery, materials, skills) are monitored and designed both by economic acquisitions and by provisions; their implementation has considerable social fall-out. If these impacts are chiefly felt at the investment level, they also have a repercussion on all lower levels (IV-III-II-I) where natural (and more or less permanent, and sometimes invincible) forces operate. Control (VI), however, if partly social and economic, is eventually of a political nature, so that the yes-or-no, now-or-later, herewith-or-therewith triggering of implementation is political.

### Social Pressures

The claims to environmental benefits can be classified in a number of ways, such as subsistence, surplus, status, exchanges, power. The variety of needs which they satisfy runs from the sheer physiological (air, water, food) through the socio-economic (housing, income) to the amenities (recreation). Such a scale suggests a sort of inverse ratio of need to right and a growing difficulty of gratification. These pressures exert themselves through the existing (and more or less static) strength of many social groups (capitalists, workers, peasants, etc.), although they can and obviously do change in kind, in force and in direction.

A catalogue of social pressures upon environmental resources cannot be drawn here. Some of the chapter headings would be: improvement of working conditions, guaranteed vacation time and opportunity, availability of private abode (not necessarily ownership), educational facilities. Since these pressures are most in evidence in the urban environment, most of them will be considered in Chapter 4.D.

I have made an attempt in an earlier publication (Dansereau 1971b) to codify the needs of individual, society and species and to contrast the degree of gratification encountered by a Canadian urban university student, a slum-dweller, etc. The significant out-

come of any such tallying is the drain upon resources and the permissible level of tapping in view of a just sharing.

## **Technical Facilities**

An increasingly broad array of mechanical devices promises an extension, an enhancement or an alleviation of human effort. The provisions made for hygiene, feeding, shelter, furniture, recreation at various times and places are a function of social values and preferences. The order of priority in which the contemporary British, French, Spanish and American people list housing, food, dress and recreation provides a good indication. The champions of technology (or of technologization) have thoroughly succeeded in their over-sell in Canadian society and displaced a good many social values such as the conscious need for space, pure air, greenery, reading, walking, etc., and increased the demand for rapid transit, rich food, constant entertainment, etc.

Many Canadians are the willing victims of their automobiles to be serviced, acres of showy lawn to be mowed, telephones to be answered, loud music not to be escaped, processed food to be eaten, etc. The literature on the victimization of man by machine is very extensive and so are the many attendant controversies. I doubt whether Canada has made any substantial contribution to the taming of technology, apart from a few isolated escapes that avoid rather than solve the problems of modern living.

## **Ecological Awareness**

Originally rooted in nature appreciation, now broadened to encompass urban amenity, this is a new force in our society and it has not yet fed back any considerable information to the social centre of motivation, nor has it strongly braked or redirected economic sway; but it has substantially affected technological research and gadgetry production. In fact, ecologically minded groups (more often than not amateurs and volunteers) have been successful in their censure of certain projects: defeating the plan for hydroelectric development on the Jacques-Cartier River; restricting salmon fishing and seal hunting in the Gulf of St. Lawrence; stopping the Spadina Expressway in Toronto; demolishing a high-rise building in Hull; and this for ecological reasons. I hasten to add that such seemingly negative actions (two of them post-factum) are paralleled by positive interference to develop new parks, to rezone entire districts, etc.

## **Economic Strength**

The market economy, on its more or less self-propelling impetus in the affluent societies, relates solely to the feasibility of resource

exploitation, unless it is restrained by a social inhibition itself filtered through eco-technical criteria. *The economic forces are the most remote from the ecosystems within which the resources lie.* Of themselves, and within the framework of their accepted obligations, multinational companies, absentee capitalists, anonymous shareholders, and imperial managers cannot be concerned with renewability except as it affects the specifically economic operation, whereas they automatically transmit, often without any buffering, the impacts of remote financial and commercial fluctuations. The economic establishment is even less responsive to what it can only classify as side-effects of its operations, the very things that the environmentalist identifies as ecological impacts (slag accumulation, pollution, slave labour, noise, general deterioration of the landscape).

In Canada the sweeping force of hard-sell advertisement induces irresponsible expenditure to fulfill imaginary needs constantly renewed by planned obsolescence. The electric toothbrush is often brandished as a symbol of gullibility and wastefulness. But there are countless other drains on our natural and economic resources, not the least the credit-card addiction.

**Political Power**

It has the last word, according to its strength and to its jurisdiction: municipal, regional, provincial, federal, almost never international. It may be a sanctioning power, in a democracy with upward relays, or it may exert the kind of leadership that allows for innovation anywhere along the line, providing that feedback (consultation) is in order. Wisdom in environmental management is no greater than the social commands that the political groups both receive and emit. Intelligence and efficiency in the bureaucracy are called upon to ensure continuity, to compensate for indecisiveness, unawareness, and ineptitude in the executives (and the other way around, as well). Interdepartmental and inter-level conflict and lack of rapport are possibly the greatest stumbling blocks. The power to spend seems overwhelmingly more determinant than actual competence.

The checks and balances of the Canadian political structure make for very slow progress to the ultimate environmental commitment, which is legislation. Perhaps this is favourable to more experimentation than would otherwise be feasible.

**Strategy**

How then do the forces of environmental control in Canada operate at this time? Referring once more to Figure 1, we seek the relays from social to technological to ecological to economic and

to political problems and decisions.

Is it possible to define, in a limited number of words, Canada's social policy? Canada's techno-scientific policy? Canada's environmental policy? Canada's economic policy? This can only be done by deduction from habitual political decisions that have repeatedly exemplified the choices that meet the people's approval. The professed empiricism of our successive governments gives those who would advise it and who would influence public opinion a certain choice of openings. Our stand in the Suez crisis, our broadening of immigration policies, our welfare implementation, our game legislation give the environmentalist his bearings that may well indicate the much-needed new direction.

There is some *social* unrest, challenges to the family as the basic living unit, to long-standing Christian morality as a standard of behaviour, to excessive and conspicuous spending. However, in spite of occasionally spectacular flares, the capitalist and bourgeois order lies undisturbed. The very disruptions of essential services (communications, medical care, etc.) are manifestations of a will to redistribute bourgeois amenities, not really to abolish or devalue them. The prospects for cutting down the birth rate are good, but they are very bad for the restraint of consumption. The attitude to immigration is ambiguous and possibly mean and suspicious, whereas foreign aid is generous.

*Technology and science* in themselves show very little orientation. Scientists have largely burst out of their earlier isolation, and no small thanks are due to the Science Council and to the Lamontagne senatorial committee (Lamontagne 1970, 1972). The reports of these two groups have knocked heads together, have nourished academic, public, administrative and political discussion. A number of other federally sponsored enquiries, notably the Hellyer Commission (1969) and the Lithwick report (1970), have brought out in the open the need for a new decision-making process. They have exposed the unacceptable consequences of excessive autonomy in certain groups, from the autodetermination of scientific research to the imposition of urban renewal, to the monopolies of fuel and communications.

It seems to have been the federal government's purpose, since about 1967, to seek new means of understanding and managing its responsibilities in partnership with private enterprise and the universities. I cannot pretend to analyze this development in its various dimensions, and will not seek out its political implications, even less its rightness or wrongness. In our present

perspective, as environmentalists, I think it is nevertheless relevant to single out the trust given to natural scientists. Thus the Science Council was and is predominantly composed of natural scientists whose impact in the many published reports is very recognizable. (I have personally deplored the virtual absence of social scientists on this body.) Nevertheless, the involvement of the natural science "community" in public debate on science policy and research allocations has contributed strongly to put environmentalists in the saddle; this has been a great step forward.

The ecological crisis was officially recognized by the creation of the Department of the Environment through the amalgamation of several pre-existing federal departments and services in 1970. It provided the most obvious proof that the Government of Canada intended to give itself the proper well-coordinated instruments to deal with environmental issues. The Canadian Environmental Advisory Council, as an independent body having access to inside information, has recognized its duty to advise the Minister on inhouse operations. Michel Slivitzky and more recently J. P. Nowlan have directed committee work along these lines, restricting themselves, unlike the Council as a whole, to areas falling under the jurisdiction of the Minister of Environment and therefore not including national parks, agriculture, energy, mines, urban affairs. It is not intended to make this report public. It is well to point out that exchange of views between Council and civil servants has been most active and cordial. In a very real sense, the CEAC's recommendations, queries and discussions have strengthened the hand of very capable administrators. The Department of the Environment has published three annual reports (1972, 1973, 1974) that give a concise account of its work. Its numerous other publications are aimed at all levels of the population, some of them didactic, some technical, some administrative and some directed to the very young.

Economic forces at play in the industrial world exert great leverage on decisions concerning environmental management. Federal departments of Energy, Mines and Resources; Industry, Trade and Commerce; Transport; and others are the official interlocutors of finance, business and industry. Nevertheless, the Interdepartmental Committee on Environment, the chairman of which is the Deputy Minister of Environment, keeps a monitory eye on "developments" and the Minister is in a position to draft regulations and prepare legislation in time.

As a result of a more adequately structured *political instrument*, it can now be said that the forces of environmental control

in Canada are in a better balance than they were. Foreign ownership, monopolies, multinational economic pressure and excessive profits are at least more clearly labelled than they ever were. On the other hand, private property, rights of access, taxation systems and transportation costs have all shifted to such a point that earlier definitions of the terminology no longer apply. This suggests that the perception of environmental problems may well have improved and that the myths of ownership, freedom of movement, purchasing power and some others will have to be replaced by more useful ones. Foremost stands the GNP which turns out to be the Gross National Expenditure and to have virtually no value as an index of the quality of life (Boulding 1970). The Prime Minister of Canada, Pierre Trudeau, has himself rejected the GNP as a standard of national health and called for a more realistic index. In fact, several federal departments, foremost of which is the Department of the Environment, are carrying out a valuable search for its parameters and denominators.

It would be unfair to say that Canada has no environmental policy because it has not yet subscribed to a well-formulated ecological bill-of-rights, and because its legislation on environment lacks integration. The leadership exercised by Canada at the Stockholm and Caracas conferences bears witness to our determination to face our problems and to put them in a world perspective.

It would serve a useful purpose if Canada's record of environmental control were written up in a readable form, and if the "state of the Canadian environment" were reviewed every year in very specific terms according to a format that would allow comparison from place to place and from year to year.

## Chapter 4 – Points of Crisis in Canada

Since this is intended as a reflection on "the state of the environment in Canada," it must identify the areas in which there is an emergency, an urgency or a problem, especially in the short-range view. The preceding chapters reveal an attempt to take a long-range view and to bring into focus the acceptable principles and the operating mechanisms, and to do so in an ecological perspective which will now be sharpened in drawing attention to actual points of crisis. I am grouping the latter under four principal headings inasmuch as the land mosaics that contain the productive ecosystems are the units that must be protected or managed in some way. I need hardly argue that a sawmill or a textile factory directly relates to a stream, a built-up zone, a road system, and a labour force, and that the integrity of a fishing stream is a function of its effluents and of its shoreline.

In fact, it is on a world basis that one can recognize the four major components of land mosaics: wild, rural, industrial, urban. They are briefly defined as follows (Dansereau 1973, a, b, 1976).

- A. **Wild** areas are virtually unaffected by direct human interference, although they may contain a highly scattered human population.
- B. **Rural** lands are greatly transformed by man, but largely occupied by exploitable vegetation and animal life, whereas the total area of human construction and permanent presence is quite small.
- C. **Industrial** occupation means purposeful harnessing of local or imported resources for redistribution or transformation by technological means.
- D. **Urban** settlements leave virtually nothing undisturbed of the primeval mineral, vegetable and animal resources and consist of almost entirely built-on space or at least profoundly transformed landscape.

Looking at Canada as a whole, in the light of land use, we find that a very large amount of its territory is wild and that the vast majority of its population is urban. Paradoxically, the Yukon is nearly the most highly urbanized part of Canada, with practically all of its population concentrated in Whitehorse and Dawson City.

A sampling of land utilization across the country will show a great variety of mosaics, some with a harmonious interfingering of

wild and rural; of wild, rural, and urban; or of rural-industrial; rural-industrial-urban; but many also that are overwhelmingly of one or the other main types.

It is on this basis that I have designed a new universal system of land-use classification (Dansereau 1973a, 1976) differing from the World Land Use Survey (Van Valkenburg 1950), the British Land Use Survey (Coleman and Maggs 1964) and the Canada Land Inventory (1970) by its ecological infrastructure (use of trophic level coefficients, as in Figure 2) and by the interpretive value of its colour scheme.

It will be useful to our present purpose to proceed in a thematic rather than regional way, since we cannot very well undertake an exhaustive survey. The Canada Land Inventory (for some time a Division of the Departments of Agriculture and of Regional Development, now part of the Lands Directorate of the Department of the Environment has fairly covered all of inhabited or medium-to-densely populated Canada, taking its cue from basic information on climate, relief, soil and natural vegetation as much as from present use, to offer a number of maps of potential showing the theoretical capacity for various affectations (agriculture, forestry, wildlife, recreation). This background information is of the greatest value to the planner. Much remains to be done in order to draw a synthesis of both potential and actual occupation and to provide a geographical framework of ecologically equivalent areas across Canada that lend themselves to fairly similar environmental assessments.

A more reasoned justification of the extrapolated potentials in each natural area would also be in order. Possibly a converted scheme of mapping (such as the one suggested in Dansereau (1973a) would allow easier regional comparison.  
regional comparison.

But, again, I cannot well undertake such a task in the present context and will seek, instead, to point out the leading questions in each of the four main areas.

# Nature





## A. Canada Wild

The argument for maintaining large tracts of the Canadian landscape in the wild state come under the following headings.

- a) The preservation of a complete repertory of primeval kinds of rocks, streams, plants and animals.
- b) The availability of essentially unmodified environments for recreational, aesthetic, and other human-oriented activities.
- c) The continuance of the wild way-of-life as an option.
- d) The need for further and continued scientific study of undisturbed ecosystems.

I shall take these arguments for granted and not attempt to develop or justify them in principle, whereas I shall seek such justifications as I review actual situations.

In a sweeping conspectus of wild lands, we can look at the Natural Vegetation sheet in the Atlas of Canada (Canada 1957, 1974) and at Halliday's (1937) and Rowe's (1972) forest maps for guidance. These documents show the major subdivisions of our country on the basis of bio-climatic units. Vegetation, being the result of a complex and long-term adjustment of flora to soil, drainage and prevailing meteorological cycles, is a reliable integrator at this order of magnitude. In a simplified scheme, the major subdivisions are (Dansereau 1971c):

Arctic Tundra  
Subarctic Parkland  
Alpine Zones  
Prairies  
Boreal Forest  
Pacific Coastal Forest  
Eastern Temperate Forest

We must then ask ourselves what are the conjunctions of resources and the prevalent land use within each one of them and what are the ownership and management régimes.

The principal questions are:

- a) How strongly, and how rapidly, are topography, hydrography, and climate modified by man?
- b) What is the variety of ecosystems within each major region?
- c) What is the distribution, size and degree of protection afforded each major and minor grouping of regional ecosystems?
- d) What are the functions and accessibility of wild lands in each region?
- e) How much is public and how much is private land?

We do not have a systematic inventory, at this time, that would consider these five questions and give adequate answers, and this is a task that should be undertaken soon. But we do have some very detailed studies that will serve as a testing ground for the present review.

Another, and even larger, question is: "How much does man's transformation of natural landscape affect the climate itself?" It is only too obvious that lumbering, agriculture, industrial implantation and urban development buffer the microclimate in an unprecedented way on the site of operation. But climatologists of experience have long been considering the possibility of a planetary displacement of thermal charges that would have continental consequences, such as the melting of major ice masses which could result in significant world-wide changes in the variability of weather patterns. Wilson and Matthews (1971) and Gates (1974) have reviewed the evidence. Bryson (1971) and others have come out in the affirmative, and Maurice Strong, the Director General of UNEP, based his cry of alarm in 1974 on the pollution-related drought in the Sahel in 1973-74 on such authorities.

Most of the crucial issues relating to wild land can be detected under the four following headings.

### Crown lands and public lands

The federal government retains property rights over most of the Territories, and the ten provinces are still in possession of large segments of their territory. Aboriginal rights apparently remain to be defined or redefined in most instances by the tribunals as to

whether they are usufructuary or outright property rights (see the Malouf judgment 1973). Public opinion in North America is just about ready to shed its traditional complacency on this subject.

The alienation of public property on lease or otherwise involves mining, lumbering, fishing, hunting, farming and other exploitations. A recent symposium (Nelson *et al.* 1974) attempted a review of the more or less reversible aspects of public use of land and use of public land. (See also the working papers of the Man and Resources Conference of November 1973 called by the Canadian Council of Resource and Environment Ministers.) The least avoidable conclusion of such general reviews is that the predominance of the rights (and rightness) of private enterprise over long-range public interest has resulted in an unplanned gnawing away of land. It was strongly indicated in both of these conferences (as well as in a resolution in one of the Science Council of Canada reports [1971] in the urban context) that fundamentalist adherence to the primacy of private enterprise no longer fully serves the common interest.

Some of the concessions of land have proven disastrous in terms of irreversible depletion of fish and wildlife, erosion and soil spoilage, permanent changes in water quality and level, etc. In many instances, however, privileges awarded to private clubs (often non-Canadian) have served as a conservation policy that can no longer be maintained in the face of demands by Canadians for access to recreational facilities and of cries by conservationists for better planned protection.

The "tragedy of the commons," as so forcefully related by Hardin (1968), casts some doubt on public ownership as a universal guarantee. Patiently elaborated education programmes and appeals to conscience are also self-defeating if they are not accompanied by coercive legislation and its honest implementation.

**Parks and natural environments** Much can be demonstrated and experimented in the setting-up of parks: federal, provincial, municipal and other.

There is something to be proud of in Canada's federal park organization: its early start, its wise policy, its level of management, etc. But the momentum may well have been lost in the fifties and sixties. It will be noticed that Québec and Ontario kept their distance until quite recently. As for provincial parks, the record is not nearly so good, inasmuch as many of them to this day do not exclude lumbering or even mining! No generalization can be made concerning municipal and private parks.

The park situation as it stands in Canada today reveals the following features.

- a) Until most recently, there has been no visible plan or purpose to set aside a park within each and every one of the major natural regional units.
- b) In spite of a plan proposed by a deputy-minister in 1947, there are still no detailed and systematic surveys of the national or other parks.

Some of the natural areas are fairly well sampled, notably the boreal forest with maritime, eastern continental, prairie-margin, montane and coastal units. Not so the prairie, the subarctic parkland, and least of all the eastern temperate forest! In this latter region (to be sure, the most densely populated in Canada) the principal variants of oak-hickory, beech-maple, pine, cedar, and northern hardwood forests are not well protected, nor are any extensive remnants of the wetland and shore-line segments.

Plans, guidebooks, nature trails and park museums abound, and some of them are unquestionably excellent. But the systematic study on a uniform methodological basis of all parks (covering the gamut of Canada's seven bioclimatic units) is not even underway. The International Biological Programme (IBP) has made considerable progress along these lines, but in a far from exhaustive fashion. Its work (now terminated) resulted in excellent productivity studies, the most exhaustive of which centered upon the grassland, but virtually none of which were concerned with Canada's largest geographic unit, the boreal forest.

The National Parks Act, 1956, is much in need of revision, if only because it is based on an outmoded conservationist credo. It leaves rather a large gap between wild lands and national monuments. Indeed, the time has come when, far from erasing all traces of man's possession of the land, many of his rural, industrial and urban artefacts are to be treasured just as much as the native spruces, anemones, cranes and bears. And essentially for the same reason. Thus, natural landscape and so-called heritage can be seen in the same perspective. Such is the avowed purpose of Heritage Canada and of the Cultural Heritage Law of Québec, both of which were made public in 1973, but neither has yet been proven.

This changing view of man-in-nature, this freer assumption of rôle and responsibility, is geared to purposive and conscientious management. It should relieve us of some of our former fears of our own destructiveness. We do have some examples of wise industrial use in a park, such as the Yoho mine, now abandoned, whose circumscribed scar is even an attractive sign of man's possession of the earth. This is not to say, from a conservationist's view, that only dead mines are acceptable. I shall argue, in the urban context, for successive use (e.g., by removing rock or gravel) of land in the urbanizing process. But I should be most reluctant to accept a policy of previous mining and lumbering for parks and other "natural areas."

## Water

Water is one of Canada's most abundant resources. Its capacity for electric power development, water supply to forest and farm land, fisheries, and possibly for export as well have long made its uses controversial, and we cannot be sure that all the right decisions were reached or that many were made at the right time.

On the largest scale, the International Joint Commission (created by treaty between the United States and Canada in 1909 and formally set up in 1912) was able to settle management controversies between the two countries where waters flowed from the one into the other. But any long-term positive operation such as the St. Lawrence Seaway (very much desired by Canada from the twenties onward and stoutly rejected by the United States until the late fifties) was very slow in materializing. Another major project is the NAWAPA scheme (North American Water and Power Authority), based in thirsty Los Angeles, and the subject of much speculation and haggling. "Canada's Water: for sale?" asks Bocking (1972).

The whole question of flood control (especially in the Great Lakes-St. Lawrence), so dramatically revived in the spring of 1974 and in 1975, and its effects on fishing, farming, industrial supply and urban development have been the object of much study. (See, for instance, Science Council of Canada Report No. 3, 1968.) Nothing short of a bold synthesis of the known facts, a better quantitative geomorphological approach, and a tighter integration into long-range multi-purpose planning will put us in possession of a workable plan for the distribution of water.

At this time, the federal government's flood-assistance bill provides some 50 million dollars of compensation. Notwithstanding the touchiness of federal-provincial-municipal jurisdictions, there is a study underway to devise means (eventually

legislation) that will not only discourage residential and industrial developments in flood-prone areas but make them as productive as they should be.

## Hunting and fishing

It is by no means assured that the full weight of our biological and ecological knowledge has been applied to the actual exploitation of essentially wild and not immediately managed (at least undomesticated) animals. An excellent symposium on this topic was organized by the British Ecological Society more than ten years ago (Le Cren and Holdgate 1962), and the problems were well posed, but the situation has not ceased to deteriorate. From over-protection to discrimination (e.g., against predators) to wholesale slaughter, the gamut is wide.

In fact, the list of threatened species is growing each year. Some people, who do not question our spending large sums of money to save the whooping crane, remain insensitive to the decimation of the wolf and are not concerned with the dwindling numbers of the peregrine falcon or the mountain lion, even less to the vulnerability of the snapping turtle or the bull snake!

Much more attention, at long last, is being given to the visibility of wildlife in parks (is this the African safari influence?) This, in turn, requires further artifices of management that an earlier generation of conservationists rejected.

Should we not go one step further and develop a really strong programme of domestication of wild animals? Some experiments with muskox are already underway, and of course, native mink and fox have long been reared in captivity. New Zealand, where red deer is a menace to the rejuvenation of forests, is turning to such practices aimed at the food market. Buffalo, deer, caribou and a number of game birds would enrich the Canadian table and provide congenial work for those who raised them.

The interactions of forest practice and other wild-land uses have not always been well balanced, as witness the insecticide sprays that also depleted animal life in the streams. This problem has come to be fully recognized, as has the disastrous effect on stream flow of lumbering too close to the water's edge. But implementation through revision of provincial laws and regulations lags far behind this recognition. The draining of swamps, unfortunately, in the minds of many Canadians is an unqualified "good thing": agriculture and highway construction have been dangerously indiscriminate in their subscription to this myth!

Our laws are our own to make and to unmake in Canada, but as far as migrants and territorial waters are concerned we must

educate others as well as ourselves. Controversies on whaling, salmon and the baby seal have brought these issues very much into the open. Facing the noble risk of unilateral action, Canada has shown exemplary restraint.

Research on wild lands could recognize the following priorities:

- a) Intensification and systematization of the national parks programme of **areal inventory and ecosystematic interpretation** development of new mapping concepts and techniques.
- b) Increase of international cooperation in **climatological research and monitoring** of the atmosphere.
- c) Continuation of the **International Biological Programme** projects on undisturbed natural ecosystems.
- d) Strong development of a **Man and the Biosphere** programme, with emphasis on man's place in wild environments.



# Country





## B. Canada Rural

The varieties of Canadian rural settlement and economy are, for the most part, coincident with the wild (or bioclimatic) divisions referred to in the preceding subchapter, Canada-Wild. A map in the Science Council Report No. 12 (1970) shows the high concentration of dairying in the eastern forest region and of cereals in the Prairies, etc. Behind the present agriculturally dominated landscapes, however, lie one to three centuries of landscape/inscape interactions. In other words, the natural potential has also been developed under the inspiration and limitations of cultural transfers and market tolerances. The very thickness of the farm-house walls and the choice of races of cattle were conditioned as much by the Scottish or French inheritance as by the cold climate.

As in the case of wild lands, the rationale for maintaining a certain proportion of strategically located Canadian landscapes in the rural state can be summarized in a few simple propositions.

- a) Growing and producing our own food will always be a necessity and it is also an inalienable backdrop of our culture.
- b) The rural way-of-life is one of the main human options and must remain open to a large number.
- c) No extensive portion of a landscape mosaic would seem to be harmonious without rural components.

Here again, a taxonomy of farm practices, an inventory of building and growing materials, would give us the insight which we lack on Canadian rural settlements. But, once more bypassing a study in depth and considering the outstanding aspects of the rural environment, we can get our bearings from the following issues.

- a) The rural-urban ratio of population distribution has reversed itself from 1871 (18.3% urban) through 1921 (47.4% urban), 1931 (52.5% urban), and 1966 (73.5% urban), to 90% predicted for the year 2000.
- b) Mechanization of agriculture has rendered unviable those farms below a certain acreage, especially in the mixed-farming regions of eastern Canada, and has

eliminated, because of topographic limitations, much potentially or previously productive agricultural land in British Columbia.

- c) A certain conception of **international balance-of-trade** and of competitive markets has led to drastic reductions in farm production (especially of cereals in the West).
- d) Regulations for uniformity and **standardization of produce** and sophistication of packaging, together with calculated release to the market, have strongly disadvantaged the local and small producer.
- e) The impact of **electronic information** and advertising has resulted (together with (b) above) in the large-scale alienation of rural labour and its migration to the urban centres.
- f) The proximity of rural land to **expanding urban areas** has made it highly vulnerable to industrial, suburban and urban development, often via the operations of real-estate speculation. A very large acreage of highly productive agricultural land is now built-over.
- g) A possible shift in the Canadian way-of-life towards greater **self-reliance** of the individual and of the family-unit would place higher value on small but very productive holdings otherwise intricated in the urban matrix.
- h) Concern over too high a degree of dependence on **imported food** may well favour a directed shift in the rate of rural-urban transfer of population and increased subsidy to agricultural production.
- i) Some **alienated urban dwellers** are moving to rural areas at the cost of a sometimes drastic loss of income; and this may be important enough to determine new planning and legislation.

These nine issues probably dominate the rural scene in Canada, at this time, and they call for an exhaustive study of rural-urban balance in all of its Canadian patterns, as well as for a comparison with other countries (most notably the Scandinavian states) where more lucid experimentation has been carried out. But study is not enough, as the Plumptre Commission has shown. Decision and action are called for.

Whereas there has long been a deliberate and rather tightly enforced Canadian policy with regard to the massive cereal output of the western provinces, and whereas the prices and costs of production of various items (milk, eggs, chickens) have been artificially controlled, it is hard to detect any but wavering policies and legislation relating to the nine issues mentioned above. Least of all does one recognize some coordination of these points in an over-all agricultural plan. One must be critical of this failure. It is due in great part to the federal system itself with its shared (and often contested) jurisdiction, but considerable improvement in inter-ministerial and inter-departmental consultation could very well take place and do no violence to existing structures. Agriculture is too far-reaching in the Canadian economy to be left solely to the Department of Agriculture. The Québec-Ontario chicken war, the Alberta-Canada fuel contest, the faulty exploitation and distribution of Atlantic and Pacific fish, bring to mind the contrasting smoothness of the privately managed orange consortium over the whole of North America.

Some of the tasks that will permit a better utilization of the rural environment in Canada at this time and that meet the issues mentioned above would be as follows.

**Land-use potentials**

As recorded and mapped by the Canada Land Inventory (CLI), they show a number of conflicts (where high values are ascribed to more than one vocation) and a good number of mistakes (where present occupation is on a low-potential site for its vocation). These data are more than ready for the computers and we could engage in a large-scale evaluation, or at the very least in a judicious sampling of representative regional mosaics. This, of course, has been done by the CLI on a very small scale for a few Canadian regions in the form of integrated land-capability maps. But it remains to be tried on larger scales.

The criteria which have been applied as uniformly as possible are much in need of critical examination and discussion. Before the dawn of eco-planning (1968?) too little use was made by planners (other than foresters and agriculturists) of this great

wealth of cartographic information. One has the impression now that some planners (mostly architects and engineers) are incapable of reading the implications or somehow unwilling to use them. The result is a very poor feedback to the authors of the maps.

## Agricultural technology

In the substitution of new tools for old, the newer are presumably considered more efficient in that they require less time, less labour and as often as not less personal skill and often result in greater, better, or different products. They are also more "energy intensive." Balancing the gains and losses, not entirely in terms of economic yield but in terms of human satisfaction, could not the bulldozer and the plough co-exist in the same landscape (as they apparently do in contemporary China)? Could the artisanal-industrial dichotomy be a manichaean lure that blinds us to a deeper sense of progress? Are we not beginning to see "progress" itself in terms of conservation of earlier forms and functions alongside our cherished innovations? (Are they indeed cherished? The motorcyclist may well love his bike, but does the farmer love his tractor as he did his horse?)

Chemical farming, from the early days of mineral fertilizers to the present era of pesticides, has provided one of the most powerful extensions of the farmer's control of his crops. In fact, the whole bio-morphology of landscape can now be chemically sculptured whereas formerly scythe and mower had to be used (Niering and Goodwin 1963). Rights-of-way are especially amenable to this procedure, but as Kenfield (1966) and Egler (1966) have demonstrated, the whole of the rural landscape lends itself to these procedures.

Table II is an attempt to contrast the positive and negative aspects of this question. The positive effects are spectacular: elimination of harmful fungi and insects, and other pests, has allowed a great immediate and at least temporary increase in agricultural yields, an abatement of health hazards and an increase in the attractiveness of horticultural landscapes.

**Table II.** Effects of fertilizers, growth-promoters, fungicides, insecticides and pesticides on air, water, soils, plants, animals and man in the rural environment. (This table, like Table I, and in concordance with Figure 2, should be read from the bottom upwards.)

Level	Object	Positive Effect	Negative Effect	
VI Control	Institutions	Productivity of chemical industries	Increase of production cost	
V Investment	Buildings, artifacts land	Cleaning out of pests Increase of revenue	Persistence of toxic substances, cost of removal; consumption of poisoned food	
IV  Zootrophy	Carnivorous animals	Liberation from pests	Consumption of poisoned animal food	Evacuation of many ecological niches Accumulation of toxic substances Removal of treasured species
		Selective killing	Unselected killing	
	Herbivorous animals	Liberation from pests and parasites Increase in growth and health	Consumption of poisoned vegetable food	
III	Plants	Liberation from competition and parasites	Upsetting of metabolic processes	
II Phyto-trophy	Soil	Fertilization, improvement	Excessive concentration of some chemicals Depletion of trace elements	
	Water			
	Air	Alteration of physical and chemical properties		

However, the poisoning of air, water and soil by industrially produced chemicals applied in massive doses, has resulted in the crippling, death and near-extinction of many forms of wildlife; in the accumulation of toxic substances in otherwise luscious vegetables and healthy-looking poultry. Much is known of course on this subject, from the surprising amount of DDT in Antarctic penguins to the high doses of mercury in lake fish to the killing off of vast masses of plankton in the oceans. Lists are periodically produced of substances to be outlawed on the grounds of their noxiousness.

It is not less well known, especially to those having attended UNESCO and UNEP conferences, that the weighting of positive versus negative effects (for instance of DDT) is not scaled in the same way in Brazil, Canada, India and the United States of America. The array of trade-offs in rich countries is comfortably large! Thus the 23rd principle of the Stockholm Conference (1972) reads as follows: "Without prejudice to such criteria as may be agreed upon by the international community . . . it will be essential in all cases to consider the system of values prevailing in each country, and the extent of the applicability of standards which are valid for the most advanced countries but which may be inappropriate and of unwarranted social cost for the developing countries."

The international debate will continue, and we must accept the near-impossibility of reaching a definitive international accord. Meanwhile, a rich country like Canada can well afford a constant revision of its chemical health laws, and this is being done to some extent by the existent legislation, although the largely negative and restrictive character of the latter badly needs a positive parallel in the form of a canon of new agricultural and sanitary practices. The Department of the Environment is currently sponsoring new legislation on environmental contaminants.

To this may well be added the heavy input of man-harnessed energy derived from fossil fuels. Thus it would seem that we may put into a cornfield more calories than we extract from it in food! In strictly ecosystematic terms, is this not wasteful?

Better still, the Department of Health and Welfare is taking a positive view (Lalonde 1974) and proposing a programme focussed on health, not illness! Happily, this is a trend in Canada that, for instance, the Canadian Association for Mental Health has adopted.

## **Quality of rural life**

There is no sense in advocating a return to old farming habits and village life-styles. These are most likely to appeal to the unproductive retired community and to present as much of a dead end as total conservation of large wild areas. On the other hand, in these days of rampant social engineering, there is no reason to accept as incompatible scientific farming well geared to market realities and the leisure and amenities of a traditional rural ambience.

Pleading once more for diversity of environment, freedom of choice, and ease of access, the congenital rural (who may well be city-born) seeks that "completeness of operation" of which Stapledon (1971) writes so convincingly. This rests in a response to the seasons, a pleasure in weather- and nature-driven hardships, in tests of survival and skill, and ability to barter. Insecticides, bulldozers and packaging need not abolish such industriousness: nor television in the home, nor a university degree, nor winters in the Caribbean. The gentleman farmer is gone, but the industrial farmer may well be a similar kind of human being, stripped of feudal condescension, geared to modern living but deriving the greatest joy from his self-reliance and productivity.

Improvement of the rural way-of-life through controlled markets, selected subsidies, better transport and communications facilities should be the object of major national and provincial programmes that can only be developed if the motivation and consensus are there. To return to Figure 1, the desire for such a way-of-life is a social objective; it is ecologically and technically well within our planning capacity; its long-run economy can easily be justified if speculation and un-planning are recognized as major evils; and its political implementation presents no major difficulties.

Making range, farm and village more satisfying is certainly one of the prerequisites of assuring Canada of a better balanced ratio of national food production.

## **Land-banks and the regrouping of farms**

The re-patterning of farm land stands out in very sharp focus as indispensable, however our social values may shift, even if the rural way-of-life mentioned above is the object of no special favour.

Many if not most of our Canadian cities are built upon agricultural land of high value and continue to this day to proliferate, often at the expense of highly productive soil. This cannot be allowed to continue for any reason. The free play of the real-estate

market must be checked. We are conscience-bound to know what we are doing, to face squarely the short-sighted trade-offs that we have accepted for several decades. It is of course true that a twenty-storey building brings forth more revenue than a cornfield on the same site, but we may bear in mind that the corn-field cannot well be located elsewhere, whereas the high-rise has a wide choice of sites. But what are and what will be the respective needs and possible locations of agriculture and urbanized residence?

The sheer obedience to an automatic triggering of real-estate values and to their self-engendered growth has led to such widespread waste and to such irreversible spoilage that it cannot very well perpetuate itself without calamitous effects. Some of these are only too evident:

- a) farmers who can no longer afford to keep and to operate their farms;
- b) city and suburban dwellers who are forced into habitat patterns (e.g., high-rise) that are thoroughly uncongenial;
- c) destruction of entire landscapes that have a picturesque value and some natural recreational facilities;
- d) destruction of historical sites, monuments and buildings;
- e) reduction of the total agricultural production, sometimes of a very specialized crop.

The Niagara Peninsula (see Krueger 1973) is a prototype of this inversion of human and historical values, of the triumph of money over amenity and pride. The lovely tissue of its orchards and vineyards and forests is shredded by industrial and suburban impingements. The beautiful Québec Eastern Township rural landscape pictured on the current two-dollar bill has just narrowly escaped being bisected by a highway!

The creation of land-banks by provincial governments is therefore imperative. A start has been made in British Columbia with the outlawing of construction on floodplain areas, and with various zoning laws which are also encountered in other parts of Canada. But no real pattern emerges at this time, and one

cannot but feel that federal, provincial and municipal governments in Canada are, in various degrees, lacking in purpose and have not even seriously studied the matter of land-banks. One would think that the development of large airports near Montreal, Toronto, Edmonton and Vancouver, which force agreements between powers, would have provided excellent occasions for the initiation of land-bank policies. But they have not.

Actually this should be part of a general agricultural policy. It is only too evident that some areas were inadvisedly developed as agricultural settlements, whereas both their soil potential and their market openings were unfavourable. The Province of Québec, for one, has belatedly closed some of these, not without political, economic and social damage, to be sure. The re-treading of the economy of such places is no easy matter, and yet it is well within the means of a society that designs super-airports and super-highways and contributes to a space programme. Much research is needed on the now underprivileged rural environment, for instance:

- a) development of new crops for the colder regions, maybe in collaboration with the USSR;
- b) setting up autarkic communities where scientific technology and artisanship coexist maybe involving consultation with Chinese communes;
- c) exemplary re-patternings of land use in areas of potential high productivity, and in areas of potential high diversity and multiple use.

It is a matter of great concern to me that Canada's important investment in the International Biological Programme (IBP) is not to be further developed by a generous subsidy to the Man-and-the-Biosphere (MAB) programme. We obviously have as much of a stake in the man-dominated environments as we have in the wild lands. Canadians also have the requisite personnel to exercise leadership in this international venture.



# Industry





**C. Canada Industrial** The industrialization of Canada stands in strong contrast to that of the Netherlands, Japan or Brazil. In each of these countries the ratio of area, natural resources, accessibility and total human population is quite different. Japan and Canada both have a large proportion of "unproductive" land but differ enormously in total area and in population density. Brazil and Canada have a broad array of natural resources that are, however, of highly different exploitability and accessibility, and Brazil has a very much greater population and a much larger proportion of unskilled labour. The Netherlands have a narrow indigenous resource base, a tremendously dense population of consummate skill and discipline; its historical accumulation of capital allows continued and high-yielding investments abroad, as against Canada's dispersed population managing rich natural resources overwhelmingly invested in by foreign capital.

Educational and cultural conditioning, political ties, wealth of heritage and collective discipline seem as important to the reception of industrial impact as the indigenous resource base itself.

From an ecological point of view, it may be useful to ponderate industrialization according to the trophic level which it most obviously affects (as in Figure 2), considering the nature of the raw materials (mineral, vegetable, animal) and how much of an energy input is required. Table III makes such an attempt. The main distinctions (from bottom to top) concern the increasing energy input, in a scale that runs from mere extraction (Block 1: mining, peat-cutting, fisheries) of raw materials *in situ* to a multi-level processing or manufacturing (Block 4: refinery, distillery, leather goods), with two intermediary groups that ensure transport (Block 2) and provide power (Block 3). I am aware that the logic of these definitions runs counter to some well-established categories. In many books, neither an airport nor a bridge nor a hydroelectric plant would be called an "industry". But such is indeed the major category they fall into if the ecological criteria I am using are to be adhered to.

The stamp of these industrial operations on the Canadian landscape varies a good deal, and no attempt will be made herewith to run up the scale and contemplate them one by one. It is however worth noting that operations in the three lower blocks (separated by double lines across the page) depend exclusively upon indigenous (Canadian) and often local resources, which is not necessarily so in the uppermost, Block 4.

The questions that arise concerning industry in Canada are the following.

- a) How does location of industry relate to landscape as a whole?
- b) How efficient is the transport system for industrial purposes?
- c) What is the geography of industrial raw materials?
- d) What is the strategy of labour distribution in industrial work?
- e) In what ways and to what extent does industry spread pollution?
- f) What is the role of inter-industrial cycling and recycling?

## Extractive industries

These questions, like those posed in the subchapters on the wild and the rural environments, are best answered in the concrete vision of Canadian industries as grouped in Table III and in the following paragraphs.

The Block 1 industries of Table III are very numerous in Canada and cover the whole territory. Mining and its attendant implementations have resulted in a craterization only equalled by war. After many decades, Sudbury remains moon-like in aspect, with its burned vegetation and bared rock. Many other sites across the land are almost as ugly, although not always so productive of a wealth that fails to be re-invested in the rehabilitation of the landscape. Pollution of air (sulphur and silicon) may well be accompanied by pollution of streams (as in the salmon-bearing Matane River in the Gaspé provincial park).

A very similar effect is achieved by quarrying and by borrow pits where gravel and sand have been extracted. In a radius of less than one hundred miles of Toronto and Montréal, the needs of road-building and urban construction have resulted in the razing of moraines, kames and eskers, the ablation of terraces, and the digging of large pits more or less filled with water. Shining examples of the reclamation of such unsightly and un-

productive areas are to be seen in British Columbia (Butchart's Gardens, Queen Elizabeth Gardens, Trail, Kimberley) and in Ontario (Timmins, Kirkland Lake), but mostly there is no plan for the successional use of these lands, although Ontario (1972 a, b) has shown some preoccupation in this direction (Bauer 1970). The Kitchener-Waterloo-Guelph-Caledon belt illustrates the occasional destruction of entire geological features, and in some of its parts the seemingly irreversible effect of surface mining.

The extraction of clay or shale for brick or ceramics involves a much lesser area. Roots (1974a) has written a comprehensive review of the Canadian mining situation where the economic emphasis and the usual lack of visibility of the mine have obscured environmental consequences. It will be some time before the specific recommendations of the Stockholm Conference (especially Nos. 56, 162, 169, 173) are incorporated into the Canadian landscape, although, as Roots points out, Canada played a major role in their drafting and adoption.

Lumbering of Canada's forests is by no means the worst in the world, but the myth of our inexhaustible woodlands is not all that far behind us and the evidence of indiscriminate cutting is still very much in view. Unquestionably more scientific and also wiser policies now prevail, although their application is somewhat ironic when a heavily lumbered area is turned into a national park (Parc National de la Mauricie). I can hardly hope to encompass all of the forestry problems of Canada, not even in their specifically environmental repercussions, but perhaps the high points can be enumerated.

- a) Natural regeneration is still the overwhelmingly prevalent practice whereas plantation silviculture is imperative now, in some areas.
- b) The effects of modification of the forest mass through various methods of management for high yield have not usually been accompanied by consideration of local (and even regional) water tables and erosion patterns.
- c) Management of the smaller stands (especially farm woodlots during the Second World War) has been very unsystematic and could well be the object of comprehensive regional plans.

**Table III.** Ecology of industry, showing (from bottom to top) the scale of trophic levels (see Figure 2) and the progressively more elaborate nature of the operation.

Objective	Trophic Level of Resource	Predominant Operation	Raw Material	Type of Industry
Block 4 Manufacturing	III, IV	Processing of products c) Animal	Wool	Textile
			Hide	Leather, furs
			Oil and fat	Food and lubrication
			Meat Fish & invertebrate Milk, eggs	Food
	II	b) Vegetable	Wood	Paper, fuel, construction
			Fiber	Textile, food
			Grain and fruit	Distillery, brewery, food
	I	a) Mineral	Stones, metals	Hardware, jewelry, metallurgy
			Rock, sand	Construction
			Petroleum	Refinery
			Gas, coal	Fuel
			Water	Bottling

Objective	Trophic Level of Resource	Predominant Operation	Raw Material	Type of Industry
Block 3 Power	I	Action of water, wind, gravity and energy release	High energy minerals	Nuclear plant
			Petroleum products	Heating plant
			Water	Hydraulic mill Power plant
			Wind	Windmill
			Electricity	Filtering plant
Block 2 Transport	I	Redistribution of minerals for transport purposes	Rock Stone Sand Metals	Roads, pipelines bridges, railroads yards, ports, airports
Block 1 Extraction	III-IV	Extraction or collection of raw materials:  c) Animal	Livestock Fish & invertebrate	Manure Fisheries
	II	b) Vegetable	Sod Muck Peat Wood	Gardening
				Fuel Lumber
	I	a) Mineral	Metals Rock Gravel, sand Clay Salt	Mining Quarry Borrow pits Ceramics, brick, Salina

Extraction of peat, muck and sod are not large-scale phenomena like lumbering and pose purely local problems, for instance, the prevalence of dust storms in denuded areas.

Fisheries (the extraction of fish from freshwater and from the sea) is a world in itself, and Canada's role in apprehending this realm by scientific inquiry is a major one. One need only glance at the shelves that harbour reports of the Fisheries Research Board and of the studies sponsored by it to envisage possibly the best-coordinated field of research on a natural resource that is available anywhere. It does not follow that we have managed our water resources adequately. What with damming, spraying pesticides, pollution of lakes and sea, all is not for the best. Moreover, the fishing force, up from the artisanal to the industrial stage, is not all that well disciplined and balanced. *The artisanal-industrial ratio may well bear resetting.* This theme keeps welling up in my examination of the environmental scene and I do believe it is an important one. The mechanical and biological damages caused by massive harvesting of sea animals now looks like a brutal technology geared to short-term yields. The vulnerability of marine ecosystems clearly demands a more delicate handling.

## Transport industries

The Block 2 industries of Table III range very widely physically (*a mari usque ad mare*) and psycho-socially. The network of seaway, railroad, highway, road, street, walk, path, spreads its arterial-to-capillary pattern in ever-denser meshes that do not always relate harmoniously to other land uses. If "surviving" is the mainstream of Canadian literature (Atwood 1972) and therefore of Canadian psychology, the communications network looms very large indeed. Years ago, André Siegfried (1937) had strongly emphasized this form of Canadian triumph of history over geography. Pierre Berton (1970) weaves his "National Dream" upon the transcontinental trek. Canadians are acutely conscious of the need of transport and communication.

The transport system is meant to ensure many positive benefits, but it bears the brunt of corresponding adversities. The present state of utilization of roads in Canada by unnecessarily large and uselessly powerful cars occasionally (chronically in urban areas) cancels out many advantages.

Thus, the positive and negative aspects of the crisis:

- a) rapid communication;      a) delayed access;
- b) easy transit;                  b) traffic jams;
- c) abundant flow;               c) superabundance of vehicles;
- d) safety;                        d) innumerable accidents;
- e) timeliness;                   e) bad timing;
- f) utilization by a variety     f) danger to all small and  
                                      non-motorized vehicles;
- g) cheaper access.               g) waste of energy; expense  
                                      of operation; unfair distribution  
                                      of costs.

The speed mania (see Parr 1974), the over-spending of roads departments, the overly uniform work-and-play calendar and the carelessness of drivers bring about additional taxes upon the quality of life, such as:

- h) air pollution;
- i) littering;
- j) noise;
- k) infringement upon other land;
- l) laying waste of margins;
- m) destruction of valuable premises.

Roads, and especially highways, are generally designed and built by engineers much dedicated to the straight line. Thus cliffs and dunes have been razed, forests have been bulldozed, marshes drained, farms have been cut-through, old houses destroyed, parks have been sliced and whole city blocks abolished. Of course, much of this was necessary, but there were alternatives in a large number of instances that were not even

considered. Picturesque, tourist-attracting areas like the Gaspé Peninsula have undergone geological rape, parts of densely-inhabited Montréal and Toronto have been disembowelled to make way for neighbourhood-severing, noisy superhighways. Since a group of Toronto citizens achieved the feat of stopping the Spadina Expressway, there has been a slight uneasiness in highway departments. Some of them have gone so far as to hire geographers and ecologists, presumably to advise them *before* decisions are made, and before contracts and investments are meted out.

At this time, transportation in Canada is afflicted with many uncertainties, all of them, in some way, related to the environmental crisis. Just to hit some of the high points.

- a) The unsatisfactory ratio of public to private transportation in most cities is the cause of many breakdowns; unchecked, it leads to acute crises.
- b) The inefficient use of private transport (one person per car) is one of the main causes of excessive expenditure and clogging of streets and highways.
- c) Parking has become a harrowing and expensive operation; it is responsible for the defacing of urban beauty and for the suboptimal use of downtown space.
- d) An overwhelming concern with rapid transit has stamped out corresponding preoccupations with the shortening of travel, the protection of valuable land, the viewing of picturesque landscape, the emission of fumes and noise.
- e) The prevalence of private transport has influenced the design and zoning of suburbs to the detriment of physical exercise and neighbourhood activity.
- f) The automobile is the principal agent of air pollution in urban areas.
- g) Noise-abatement laws and speed regulations are both insufficient and unenforced, especially where sports cars, motorboats, motorcycles and snowmobiles are con-

cerned, so the dangers to physical and mental health constantly increase and most forms of wildlife are eliminated.

- h) Over Canada as a whole, and within each province, there is little coordination and planning of the competing services of steamship, plane, railroad, bus, truck and private car.
- i) Walking is a lost art.

The transportation-related industries are probably better identified as environmental hazards: bridges, ports, jetties, airports, aqueducts, pipelines, rights-of-way, log-floating rivers, etc. The relation of all of these facilities to the quality of air, water, soil, plants, animals and to human investments in agriculture, industry and urbanization has resulted in many public controversies.

The Mackenzie pipeline and highway projects provide good illustrations of the issues involved. The construction of the oleoduct would affect various topographies and soils, from the extremely vulnerable permafrost through the podzolized forest to the prairie and steppe types; it would destroy and otherwise modify vegetation along a major productive valley floor; it would thereby change the habitat-structure for all forms of animal life, also serving sometimes as a brand-new migration highway and sometimes as an obstacle to migration (Pearse 1974, McTaggart-Cowan 1974, Environment Protection Board 1974).

The channelling of water, for instance, if the NAWAPA scheme (North American Water and Power Alliance) were adopted (Bocking 1972), could have even more catastrophic effects (see next section).

What ledger operations will give an accurate account of rights-of-way? What is lost and what is gained? How is the cost of their up-keep recuperated and to whose advantage? A long-time student of this very question, Frank Egler (1958, 1966, 1970, 1973, Egler and Foote 1975), has sounded warning after warning, and made a number of very concrete proposals based upon his own experiments and those of others. He has well shown that

natural vegetation can be stabilized after the construction of power lines to the extent of eventually reducing upkeep drastically, and thereby improving the aesthetics of the landscape as well as its productivity for wildlife. One will not find many applications of these techniques in Canada, where power lines almost inevitably follow a straight (and not too narrow) path, and cut an ugly swath through forest, field, farmland and suburb. However, a dawning consciousness of the productive alternatives is shown by the James Bay Energy Corporation which has contracted for an "ecological right-of-way."

Another communication line, of utmost importance to Canada, is the network of commercial navigation waterways. A recent consultation between the Department of Industry, Trade and Commerce and the Department of the Environment has led to a new tentative mapping of navigation channels intended to avoid areas of concentrated fishing and fish-breeding in the Gulf of St. Lawrence. A similar conversation is underway on the Pacific Coast.

**Energy-producing industries** The industries in Block 3 of Table III probably thrust the greatest change upon the environment. The official document *An Energy Policy for Canada* (Macdonald 1973) is intended, as its subtitle indicates (Phase I — Analysis), to provide factual grounds for discussion and eventual development of a national energy policy, as yet unformulated. In all fairness it should not be read as condoning the present trends, even if it recognizes as a fact that Canadians are geared to an unconditional growth objective. The preliminary statement expresses this very well:

"Canadians are heavy users of energy. Our per capita use of energy is the second highest of any nation in the world. On the average, each of us uses each year energy equivalent to that contained in 55 barrels of oil. Much of this energy is required to achieve a reasonable material standard of living in Canada, but an important part also goes to enable Canadians to enjoy, by choice, the life style and the activities that they find satisfying. Our aspirations and concepts of desirable life styles are continually changing, but improvements in the quality of our lives are not likely to be accompanied by a future reduction in the net per capita use of energy. To a large degree the quality of life enjoyed by Canadians is, and will continue to be, determined by how we employ energy not needed for our basic material existence."

"Although adequate energy is essential to a high quality of life, increases in the use of energy will not necessarily lead to improvement in the quality of life. Improvement may depend largely on having a range of choices available, and on the ability to make choices with a balanced perspective of immediate and long-term consequences. Our energy policies play an important role in enabling Canadians to have adequate energy for their needs, and in directing its use towards attainment of the objective of a satisfactory and improving quality of life."

A three-and-a-half page chapter considers "Energy and the quality of life in Canada" and the theme of clean living is later woven more or less into the text. Actual projections are made concerning the costs of an environment of high quality which are not all that exorbitant relative to the cost of energy production itself. It may be that we do not want a clean environment as badly as we do economic growth. The report insists that "Reduction or restriction of energy use is not an effective way to reduce or control unwanted changes in the environment" (page 279 of Volume I) and goes on to state that we can have both. The following principles are set down for the next three decades pp. 130-131, Vol. II.):

- "a) The total mass of transient or short-lived air pollutants delivered to the atmosphere in any given part of Canada shall not exceed Canadian and international air quality standards;
- "b) The addition of persistent or cumulative pollutants to the atmosphere, waters and soils be known and firmly controlled;
- c) The survival and natural range or distribution of Canada's native flora and fauna, including species found along our seacoast and in our territorial waters, should not be endangered by energy activities, except where, with the knowledge and participation of biological and environmental authorities, the consequences are weighed beforehand and a decision to proceed or continue with the energy activity is made by agreed procedure;

- "d) Canadian landscapes and coastal areas will not be significantly disturbed by energy activities, except where such change is planned and controlled, with provision for restoration or public compensation;
- "e) Release of radioactivity or radioactive materials should not exceed amounts presently anticipated and internationally accepted as being of insignificant threat to biological activity;
- "f) The discharge of oil and related hydrocarbon products into the ocean, either directly, by flushing from the land via rivers, or by the precipitation from the atmosphere, will be reduced from what it is at present, and held at a rate that does not exceed the capacity of the oceans to degrade and assimilate the material received; action must be taken to prevent cumulative build-up of persistent compounds; and the statistical risk of unexpected or catastrophic discharge for any given amount of petroleum products transported on or under the ocean, must be considerably lessened;
- "g) In any local area, pollution or adverse effects from any energy activity will not endanger human health or, in the light of the best technical knowledge available, have an important influence on the functioning of the ecosystem."

Some will take a pessimistic view, thinking that it requires a great deal of scientific and technical imagination to devise a plan (hopefully not too coercive) that will permit continued growth and the attainment of these goals. There are all too few signs of active endeavour along these lines among scientists, technicians, administrators, industrialists, etc. And of course, a shift in expenditures and consumption must be desired by the people. The report in question properly refers to consultation.

An appeal to such realism is more often than not a plea for the status quo, and therefore, in the present juncture, for the maintenance of economic predominance in the decision-making process (as in the upper block of Figure 1). I refer only to my comments in the initial part of the present report for a more complete view of the limits-to-growth controversy. But perhaps this is

the place to draw attention to symptomatic stirrings on the part of such establishment-oriented bodies as the National Research Council and the Science Council of Canada. One of the latter's recent reports (No. 19, 1973) recalls earlier statements (No. 2, 1968; No. 14, 1971b; No. 16, 1972) that are more rhetorical than otherwise, and also recommends the perusal of Ward and Dubos' (1972) *Only One Earth*. However, its Executive Secretary, Patrick McTaggart-Cowan, made a public statement in June 1974 to the effect that it is the limits-to-growth issue that has to be taken "head-on". This will cast some doubt on the so-called need for very large quantities of energy; or, at the very least, it questions the growth imperative itself. Thus, our attention can be refocused on the environmental changes in terms of total gains and losses and new choices can be made, including the decision to rein in the exploitation-production-consumption chain.

To take the example of hydroelectric development, I have tried to show in Table IV the line-up of impacts as they can be expected to strike, at the minerotrophic level, in an area like James Bay. A thorough upsetting of the air-water-soil base induces a re-assortment of resource availability, the main purpose of which is unquestionably to channel the forces of nature towards the production of electricity. What Table IV points to is precisely the shift from processes that have been conjugated over a very long period of time and have induced a more or less self-perpetuating balance to suddenly induced new ones, unrelated to the forces of the landscape. The engineering interventions are in the nature of releases and concentrations of energy and therefore highly promising of unprecedentedly high levels of efficiency. It is by no means a foregone conclusion that at levels II, III, IV, and V (not shown in Table IV) all effects on plants, animals and man will be "unfavourable." Populations of trees, invertebrates, fish, birds and mammals potentially stand as much to gain as to lose. But the losses are likely to be very high if they are not foreseen and no gains will be forthcoming without planning.

Table IV. Normal functions and the disturbances of processes at the minerotrophic level.

Process	Natural Balance	Intervention	Secondary Stage
Cosmosphere — atmosphere	Heat, light, energy, high summer maximum, low winter minimum	None	Same
Radiation	Gravity constant	None	Same
Atmosphere — air	Light, heat, precipitation determined by anticyclonic Keewatin air mass; (see climatic diagram)	None	Same
Radiation Condensation			
Atmosphere — water			
Precipitation			
Air — water	Flow and accumulation basins of seasonally stable volume	Flow and accumulation basins of non-stable, unseasonal volume	Change of rate of all processes
Precipitation			
Evaporation			
Water — parent-rock	Confined to basins geomorphologically stabilized by floods	Inundation and exondation of levels not under such an influence	Initiation of new forms of relief and shifting of shorelines
Irrigation			Crustal loading and displacement of stress
Erosion — sedimentation			
	Continuation of initiated cycle	Initiation of new cycles	
Air — parent-rock	Progressive and following rhythm of floods	Exposure of flooded layers; flooding of emersed layers	Persistence of constant temperatures on flooded land
Warming			Drying-up of emersed areas
			Extreme variations on areas suddenly exposed

Process	Natural Balance	Intervention	Secondary Stage
Precipitation	(See climatic diagram)	Change of ratio between surface rock — water — vegetation	Emergence of numerous new microclimates
Erosion	Eolian action on light soils, forming stabilized dunes	Exposure of new layers of sand	Initiation of new cycles
Parent-rock — soil Weathering	Progressive and constant physico-chemical changes of bedrock elements and liberation of particles	Burying, immersion, or exposure of new layers	Immobilization of already available resources Reinitiation of pedogenic processes at zero
Erosion — sedimentation	Geomorphological processes constantly determined by physiography and drainage	Deviation of watercourses, accumulation of water reserves	Stop and/or reversal of erosion — sedimentation ratio
Fossilization	Indefinite accumulation (with or without pressure) of resources physically, chemically, and biologically unusable	Exposure, burying, submersion	Liberation of fossil resources or acceleration of fossilization
Air — soil Aeration	Penetration to a characteristic depth in each type of soil	Mechanical and hydrological shuffle	Reversal of aerobic and anaerobic processes
Precipitation	Continuation of air — parent-material process		Change of ratio in precipitation — reserve-flow

Process	Natural Balance	Intervention	Secondary Stage
Evaporation	Stable adjustment of precipitation — evaporation		Change of ratio of precipitation — evaporation: new surpluses and deficits
Water — soil Irrigation	Geomorphological and pedological processes adjusted to present regime, with stable suspension — solution — transport ratio	Radical change of hydrologic regime in certain parts of the watershed	Unbalance of total irrigation network: change of balance in suspension — dissolution — transport ratio
	Constrained by present parent-material and geomorphology	Outflowing or regressing in present network	Erosion — sedimentation locally reserved

## Manufacturing

The Block 4 industries of Table III are so diverse that lumping metallurgy, distillery and textiles together may seem artificial. It is not so, I believe, in the present context, inasmuch as the geographical location of most industrial plants (whether they use mineral, vegetable, or animal raw materials, supplied *in situ* or from afar) obeys very similar requirements. The manufacturing ecosystems need access to constantly renewed raw materials, they must have an uninterrupted amount of power, a reliable work force and an assured system of transport and marketing. A refinery, a paper mill, a shoe factory all have an ugly metabolism that has made them, since the beginning of the Industrial Revolution, the polluters par excellence! Rather more so than the industries of the other three blocks shown in Table III.

A picture of industrial Canada, if it could be mapped in some detail, would show the energy charge in terms of the number of successive processes involved in the elaboration of a product. The extraction of gravel which is immediately spread on a nearby road involves a small expenditure, whereas the delivery of a pair of shoes in a retail store is the last act of many, from the breeding, feeding, capture and killing of the mammal, the stripping and tanning of hide, the cutting and sewing of leather, the designing

and assemblage of a shoe, its ornamentation and polishing, its packaging, advertising, display, sale and delivery to a wearer. If we can look at this sequence with a truly ecological eye, we are bound to ask ourselves what the hazards are in each of the several ecosystems where at least one stage of treatment occurs (pasture, stockyard, train, slaughterhouse, factory, warehouse, store).

Proceeding according to the levels of Figure 2, the hazards can be identified as to the impact of Block 4 industries as shown in Table V.

For instance, a pulp-and-paper plant releases sulphurous fumes into the air, mercury-laden effluents and bark and other vegetable waste into streams; the aquatic and riparian vegetations are affected by the abrasive effect of the floating logs, by the coating deposits in the bed of the stream, by the tannins and other suspended material in the water; insects, invertebrates, fish and other wildlife are affected by all the above-mentioned pollutants and growth-inhibitors as well as by the altered condition of plant-growth; food chains (especially the herbivore — carnivore relay) are shortened, sometimes cut off. In a completely wild setting, the opportunities for bio-reduction are greater although hardly sufficient; in a rural landscape the pulp-mill merely adds to fertilizer, pesticide and sewage problems; in a city it is a strong contributor to pollution.

**Table V.** Impacts of Block 4 industrial occupation of land. (This table must be read from the bottom upwards, so as to follow the scheme of Figure 2.)

Level	Resource Affected	Action of Plant	Effect on Resource	Impact
V	Wild area	Replacement of existing ecosystems or investments	Partial destruction and contamination	Irreversible change in resource base
	Rural Area		Contamination	Loss of human physical and mental health
	Urban area		Substitution, contamination	Alteration in real-estate values
IV	Carnivorous animal population	Reduction of quality and numbers of prey	Loss of diversity and quantity of food Toxicity of prey	Damaged metabolism, disease Replacement by "pests"
III	Herbivorous animal population	Damage to vegetation	Loss of diversity and quantity of food Toxicity of plants	Death Need to migrate
		Spraying Condensation Drainage	Deposition on external tissues, absorption	Reduction of metabolism, disease, Replacement by "weeds" Death
I	Air	Release of fumes	Alteration of physical and chemical content	Pollution Solid wastes
	Water	Effluents		
	Soil	Infiltration		

Where does the manufacturing industry stand, in Canada, as far as environmental adaptation is concerned? A brief rundown of the Block 4 industries mentioned in Table III can be made in answer to the following crucial questions, which concern: landscape, location, human ecology, zoning legislation and recycling.

- a) Where are the plants located? In wild, rural, industrial, or urban landscapes?
- b) Have the environmental conditions of soil, wind direction, stream proximity, natural vegetation, nature of settlement been considered at the time of location? Afterwards?
- c) Has the human habitat been planned in the place-of-work ecosystem? The residential ecosystem? The recreational ecosystem? The transportation ecosystems?
- d) Does the industrial plant fit a particular niche in municipal zoning?
- e) Are preventive measures being enacted as well as corrective ones? Does the management respond to environmentally designed planning?
- f) Are by-products and wastes the object of recycling practices?

Some partial answers to these six questions can be given which will help to set our sights in the perspective given by Table V.

- a) *Landscape.* Oil refineries, tankers, cisterns, petroleum product distribution centres occupy wild areas (Norman Wells, N.W.T.; Mont-Louis, Gaspé Peninsula), rural areas (Thompson, Man.), industrial areas (Montréal East; Burlington, Ont.), urban areas (St. John, N.B.; Vancouver). A similarly wide spectrum is achieved by the pulp-and-paper installations and to a lesser degree by distilleries, breweries, textile mills, leather-goods plants that tend to be in an urban setting, are sometimes in a rural one, but not often in a wild landscape, whereas they are usually not large enough to create a properly industrial landscape. The food industries are, by and large, rural and urban.

b) *Location.* Meat-packing, fishmeal, and pulp factories are, as often as not, upwind from urban or village settlements or otherwise too close to them. The decision-making on location and purchase of lot would seem to be economic-technical and to contain hardly any social or ecological elements, although an increasingly evident force is political (i.e., labour-management contests). Political issues also weigh in the choice of site since the ten provinces and the territories do not have the same (strict, costly, well-enforced) environmental and labour legislation and regulations. The preoccupation with social amenities preceded by one or more decades the concern over environment. Therefore lounges, restroom and restaurant facilities, games and entertainment preceded landscaping and new architecture in Canadian industrial plants. The best is now being made of unsuitable locations and compensations are sought for inappropriate choices made in the past.

c) *Human ecology* principles, foreshadowed by the endeavours of industrial social workers, may now be applied. The stock of information however is very low. It seems to have been no one's business to measure the responses of workers to their physical, biological, social, economic and political environment in their place of work, their place of residence and in the commuting spaces. An ecological background needs to be sharply etched as a framework for the study of physical and mental health — and, by implication, of individual and collective fulfillment. The Canadian Association for Mental Health, among other public institutions, has incorporated this kind of thinking into its programme. The Lalonde report (1974) has put the federal government on record, well beyond pious intentions. It may well be a new point of departure!

d) *Zoning* has for some time restricted the free establishment of new industries and has been instrumental in shutting out some of them. This has been increasingly obvious in the larger urban centres, but is not too apparent in rural areas where huge cisterns block the view of fine architectural and natural prospects. In fact, zoning is the latter part of planning (more about this in the sub-chapter on urban Canada).

e) *Legislation* on environmental use has tended to be focused on abuse, in the first years (from 1965?) of the "environmental crisis." Although Canada has moved already into a more positive phase where the planning of resources as a whole and the management

of land itself are in honour, the punitive measures are still with us. They are by-and-large rather paltry and inefficient. The cost of adapting cleaning devices to old machinery is alarming to the owners and producers that do not all enjoy the advantages of the planned obsolescence that graces the automobile industry. There are plenty of signs, nevertheless (whatever the motivation may be), that industrial design has moved into the environmental phase. Canada has no spotless, aesthetically pleasant, clean-smelling refinery comparable to Idemitsu, Japan's major establishment of this kind at the gates of Tokyo, but it does have a number of good-looking "industrial parks"; some of our rivers have been cleaned of floating logs; the fumes of many industries have been abated. But Sudbury, Murdochville (Québec), and many other industrial centres still wallow in a mixture of opulence and ugliness.

f) *Recycling* is not the order of the day. It is considered primarily as an economic problem and is more often than not dismissed on the grounds of its costliness (no returnable bottles for soft drinks in Nova Scotia). It is inseparable from the problem of waste-disposal and is of course contingent upon our view of resource supply for the future and limits to growth. We have no system or plan of transfer of by-products and wastes from one industry to another, nor yet from the urban or industrial to the agricultural exploitation. Such society-wide programmed thrift could result in substantial savings and sparing of the environment.

In his introduction to the Royal Society of Canada's symposium on "Waste recycling and the environment," Roots (1974b) says that our handling and management of waste is "not so much a technical and economic operation as an attitude of mind".

The Science Council of Canada Report No. 14 (1971b) emphasized recycling as one of the main issues in the Canadian environmental turnover. As we develop a more satisfying index than the GNP for the appraisal of a well-balanced society (Boulding 1970) and propose a more acceptable (and possibly more "realistic") accountancy for hidden costs and eroded benefits, a more austere housekeeping is likely to prevail. Many large companies advertise their exclusive use of recycled paper; some manufacturers of beer and soft drinks use returnable containers; a very few restaurants feed their garbage to pigs.

Nevertheless, as I have noted in Chapter 1, a shocking amount of potentially useful material is wasted, such as:

- a) Food left over on plates in restaurants, which public health regulations condemn to garbage status, and which could feed pigs, livestock, etc.
- b) Paper by the ton is thrown away every day; private households, universities, places of business only rarely send it to recycling plants, of which there are only too few.
- c) Bottles and glassware are for the most part disposed of in garbage.
- d) Metal objects, old cars, and various kinds of hardware are thrown away, often littering the landscape.

An austerity programme (joyous if possible) is decidedly necessary, including restricted consumption and maximum re-use. With respect to the above items, the following footnotes can be added. a) A recent Federal Public Health Survey (Lalonde 1974) has shown that Canadians eat too much and exercise too little. b) Our newspapers are much too bulky; strict rationing (for all!) of advertising space could reduce the mass considerably. c) and d) Nothing short of semi-coercive municipal and provincial collection and recycling programmes will meet the issues of wasted glass and metal.

The Canadian industrial landscape therefore suffers from a faulty integration into the various regional mosaics. It tends to disrupt the wild and the rural fabrics and it perverts the urban tissue as well. The neuralgic points are the following.

**Extractive** operations should be planned in such a way as to foresee regional development in terms of successive uses and consequent saving and/or timely utilization of resources. For instance, quarrying or gravel removal to precede recreational or urban development; sod or peat or lumber stripping to precede industrial building. Actually, Canada has endorsed resolutions 167, 169 and 173 of the Stockholm Conference which makes just such provisions.

**Road, airport or waterway** should adopt long-range patterns of multiple use and flexible resolutions of competing functions. A livable rationale of communication networks should not be geared to speed and economy at the expense of amenity and choice.

**Energy production and distribution** are so pervasive that they cannot be left to obey economic forces and international pressures without a strong federal buffering.

**Anti-pollution standards** cannot be absolute (e.g., above and below so-much-per-cent concentration of a pollutant) but must be geared to different environments (at least on the order of magnitude of wild-rural-industrial-urban) at different times. Moreover, they have little meaning if they are not tied to positive environmental management principles, regulations and laws.

**Depreciation of artificial industries** should lead us to reconsider the geographical distribution of factories that depend almost exclusively upon imported raw materials (such as the textiles) and that owe their presence to now-terminated historical conditions.

**Decadence of small industries** poses the whole problem of the utter replacement of an artisanal way-of-life by an industrial one. There are good social and political reasons to maintain the small fisherman, the blacksmith, the cabinet-maker alongside the trawler, the iron-works, the furniture plant. The dealing-out of social benefits (so very much a part of the capitalist society relieved by the welfare state) can well be channeled along these lines.

**Conversion of work schedules** has not gone nearly far enough. Automation and other causes have reduced the labour force and the working hours (and days), whereas the new architecture and the new urbanism seek full-time use for all buildings and facilities (plants, schools, churches, homes, public buildings). An economically more egalitarian society will have no great trouble in reforming its calendar to meet both of these basic requirements.

**Political reform**, possibly beyond the areas of concern of Canada's present constitution, is no doubt in order if the forces that really activate the industrial effort are to be reflected in the administrative and political structures. The legislative, executive and judiciary bodies that now direct and arbitrate the conflicts of

property, management, technology, labour, production and distribution are patterned after a paternalistic order that has ceased to live.

There may be little need to intensify industrial research as such: our growth-oriented society supports these endeavours very generously, although there is some question as to its support of the right kind of industrial research. As far as industrial impact on environment is concerned, it is obviously lagging far behind productivity-oriented studies. The following areas might be particularly worth developing:

- a) Psychological as well as physiological research on the effects of pollution of air, water, soil and food.
- b) Socio-psychological research on the impacts of noise and of different transportation circuits.
- c) Socio-economic studies on the means and costs of improving environmental quality.
- d) Future-oriented economic studies based on the hypothesis of shifted consumer priorities.
- e) Technological and socio-economic research on recycling.
- f) New research on alternate sources of energy (solar, eolian).

# Town





## D. Canada Urban

The ecological searchlight on urban areas is just beginning to reveal unsuspected aspects of the town as a human habitat. This is not the place to draw a historical perspective of the application of specifically ecological thinking and methodology to the urban milieu. A search for origins and ancestors would take us very far back. We need hardly look to earlier sources than Patrick Geddes (1915) and R.E. Park (collected works, 1952). A fuller blossoming of human ecology *avant la lettre* is to be found in a retrospective of the development of Lewis Mumford's (1972) thinking about man and society, with a strong emphasis on urban man and an abiding awareness of the elusive conditions of his fulfillment.

I have attempted elsewhere (Dansereau 1966, 1969, 1970b, 1971) to encompass the forces of the escalation of man's impact on his environment, taking many cues from Mumford (1972) and also from Sears (1966) and Sauer (1967), but mostly trying to remain within the methodology created by plant and animal ecologists. It is on that basis that I was led to formulate a classification of land uses (Dansereau 1973a) which I have used above as a framework for the present review (wild, rural, industrial, urban).

My previous ventures in urban ecology have been cooperative, inasmuch as they were geared to a 1968 symposium in New York on "land, air, and water for man in megalopolis" (Dansereau 1970a), a federal task force on housing and urban development (Hellyer 1969) and a Science Council Committee report on *Cities for Tomorrow* (Science Council of Canada 1971b).

The choice of issues singled out for study in the last two reports still seems to hit the high points of urban environmental crises in 1975. I believe we can stoutly stand by the recommendations that were made at the time. The Hellyer report considered six areas and passed some 44 resolutions.

1. Financing (resolutions 1-11);
2. Land cost and utilization (resolutions 12-16);
3. Construction costs and techniques (resolutions 17-23);
4. Social housing and special programmes (resolutions 24-29);
5. Urban development (resolutions 30-41);
6. Research (resolutions 42-44).

The Science Council of Canada considered five areas and offered nine resolutions.

1. The city as a system (resolutions 1 and 2);
2. Urban transportation (resolutions 3 and 4);
3. Housing and community building (resolutions 5-7);
4. Recycling and waste in the urban environment (resolution 8);
5. Communications between citizen and government (resolution 9).

The report by Lithwick (1970) made a strong argument for "sound urbanization" being "linked nationally" and for the urgency of "managed growth" if we are to achieve "a greater ability to choose desired life styles."

A good number of the resolutions contained in these three reports have actually been implemented, notably the establishment of a Ministry of State for Urban Affairs.

However, the purpose of the present report cannot be to follow up on all 53 of these resolutions in order to evaluate Canada's progress in taking stock of its urban problems. It is all very well to say that all the above-mentioned areas have environmental dimensions and raise ecological issues; it is certainly more appropriate, here as above, to regroup the pertinent questions in an environmental framework.

Thus, some of the realities most obvious on the urban scene today in Canada are the following.

- a) Cities are growing in size, area and population, and also in number.
- b) They are increasing their capacity to control wild, rural and industrial landscapes.
- c) Most of them grew without a proper plan, and are obeying almost exclusively economic imperatives in their rate and direction of growth, and are not subjected to regional directives (and not too obviously to provincial ones).

- d) **Pollution** (chemical, physical, visual, acoustic) is rampant, too expensive to correct, impossible to prevent.
- e) **Housing is inadequate** in quantity and quality and leaves little choice to the individual or to the family.
- f) **Poverty and idleness** have become the characteristic of most large cities, ever since the beginning of the Industrial Revolution.

Perhaps I can attempt to sort out the positive and negative aspects of these afflictions by regrouping them under six more positive headings.

1. Urban/non-urban patterns and processes
2. Urban structure, growth and size
3. Housing
4. Transport
5. Planning and zoning
6. Amenities and recreation

In considering the issues that arise under each of these items, we are bound to look for the goals that a well integrated city should keep in view. Desautels *et al.* (1965) very graphically set their sights on eleven objectives, as follows.

Adequacy  
Accessibility  
Variety  
Legibility  
Singularity  
Stimulation  
Identification  
Health  
Security  
Comfort  
Resilience

Such an enumeration (well defined and expertly applied to metropolitan Montréal by the authors) reveals as strong a concern for perception as for design. The influence of Blumenfeld (1949) and of Lynch (1960, 1961) are, of course, evident. I hope that I am also following their lead in recasting the interaction of these objectives in a somewhat simplified and more inclusive way by grouping them under four headings.

- a) **Diversity** in a city consists in the interdigitation and compatibility of as many functions as possible within the neighbourhood cell (residence, commerce, services, recreational and cultural facilities, places of work).
- b) **Health** in a city consists in the good repair of all facilities (including transportation and residential) and freedom from pollution (including noise) and easy access to care.
- c) **Efficiency** in a city consists in smoothness of operation, suitability of work-forces to tasks, average to high productivity, adequate consultation.
- d) **Amenity** in a city consists in relative freedom of choice in abode and occupations, ease of access to essential and non-essential facilities, participation in neighbourhood (and city) decisions, pride in collective aesthetic and social achievement.

One would like to designate a city, in Canada or elsewhere, in the present or in the past, to which very high points can be given on all four counts. Were not the amenities of Athens, Rome, Paris, London achieved at the expense of a suffering minority — indeed a suffering majority? Injustice, poverty, oppression have had historical (sometimes ethnic) origins, but they have had and still have highly visible ecological consequences and dimensions. Pollution, malnutrition, frustration, crime are rampant in the centres of high efficiency and great wealth, such as New York, Tokyo and Berlin. We shall obviously have to deal with relative obedience to these four principles. Thus, Montréal rates much higher than New York, but not so high as Helsinki or maybe Auckland.

As we consider the six problem-areas mentioned above in the light of the four orienting principles, we can take stock of the Canadian urban environment (without losing our bearings on the

international perspective) and face the issues that most squarely confront us at this time and the studies and resolutions that they cry out for.

#### **Urban/non-urban Patterns and Processes**

The landscape matrices within which our cities are encased vary a good deal and afford contacts with wild, rural and industrial land uses that could be harmonious, but that are all too often chaotic and dysfunctional. The half-moon of Toronto opens on the vast expanse of Lake Ontario; Montréal straddles two islands and sprawls upon the south shore of the St. Lawrence; Vancouver stretches its tentacles along a marine inlet and stops abruptly against steep mountains; whereas Winnipeg, Saskatoon and Edmonton are each traversed by a more or less encased river and spread radially into adjacent flatland. Thus the possible contacts between A, B, C and D (wild, rural, industrial and urban, as defined above) are constrained in very different ways.

The relation of the city to water and highway is a prime determinant of its original location: the great capitals of history (Toynbee's *Cities of Destiny* 1967) all appear as ports or cross-roads. Much has been written on this subject and I can hardly begin the exercise of a bibliographic listing. It must be remembered that Geddes (1915) and Mumford (1924) not only had an early perception of the problems of integration of the city into its landscapes but also formulated their views with exceptional lucidity. One does not know what is more astonishing: the prophetic view or the heedlessness of the Century. Lavedan's later (1936) analysis of how cities are put together led to Lynch's (1960, 1961) less morpho-architectural and more socio-physiological definitions. Other re-assessments such as Smailes' (1953) and Reissman's (1964) have followed. The latter specifically searches out the ecologists' contribution. Waller (1972) comes closest to our present topic in his search for quantification of city-hinterland relationships, although his approach is more economic whereas Smailes' is more geographic. Doxiadis' (1968) monumental work offers a sophisticated analysis of urban patterns that much exceeds the present compass. Let us note, however, that he has provided urbanists with a new conceptual framework with his pentagon: *nature, man, society, shells and networks*.

I do believe that an environmental approach to the genesis and differentiation of an urban tissue at the expense of rural or wild land and with the ingrowth of industrial investments calls for a consideration of two principal aspects: structure and polarization.

The structuration of urban investment is very apparent in the larger and older establishments where it is seen to depend upon level VI ecosystematic trophic operations, such as financing and government. The distribution, size and area occupied by buildings and their function as centres of control (and not of production) are decided by very strong politico-economic interests. Downtown Montréal, Toronto and Vancouver are shaped as much by international input and command as by local need. The ruthless elimination of residential facilities gives them a hard-core urban cast of concentrated daytime and weekday activity and night-time and weekend desertion that stands out as the extreme, concentrated, specialized form of urbanization. This can only increase with an ever-shortening work-week — unless we at long last decide to reform the whole work calendar.

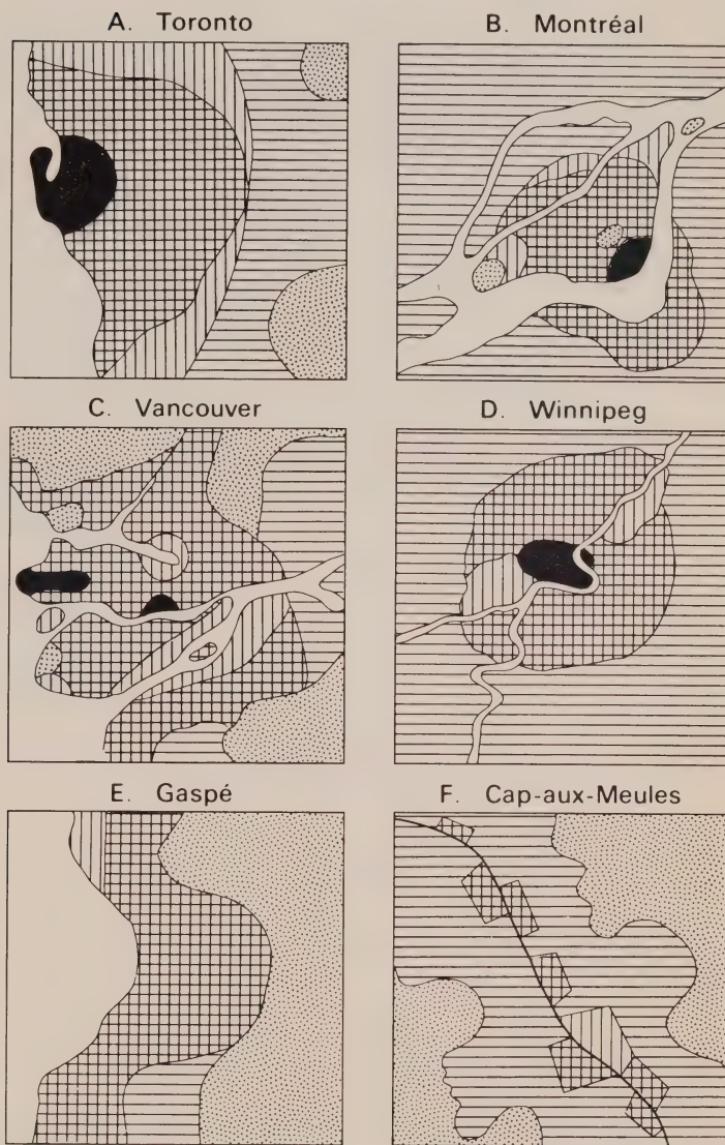
In fact, the emergent shape of a city reveals the resolution of conflict between an inner design and outer constraints. The rose or the checkerboard of which Lavedan (1936) speaks in relation to older European urban developments sometimes triumphed over minor topographic obstacles. Washington is the perfect rose but Dallas is not. Humphrey Carver (1962), in word and drawing, has admirably typified these growing pains.

Hans Blumenfeld (1949) and Kevin Lynch (1960, 1961) have both emphasized the prevalence of pattern over size. Under the direction of Blumenfeld *et al.* (1966) an attempt was made first to review, on a world basis, the patterns of cities (Barre *et al.* 1966) and to apply these findings to metropolitan Montréal (Jérôme *et al.* 1966). We could well take our cues from this monograph (unfortunately unpublished) to gauge the structure and function of Canadian cities, where we can find examples of the principal types (dispersed, galaxy, linear, concentrated, ring, chain and star).

The obedience to physical and physiographic factors on the other hand, and the thrust of expanding commerce, the spread of residential requirements call for regional solutions, to be sure, but they call for planning projects that may well be modelled upon solutions already reached elsewhere.

It would be profitable at once to seek out the antagonisms of form and function and to characterize the latter in terms of land-use types with different trophic-level dominance. Thus, where the urban tissue is feebly embedded in a rural matrix, mostly without benefit of an industrial buffer, level I to IV trophic operations tend to be dominant, and the impact of V and VI, so influential in structured urban landscapes, is not too apparent. On the contrary, in a fully developed metropolis, it is the minor

**Figure 3.** Six patterns of urban/non-urban contact, showing distribution of land uses. (These highly schematic maps are not drawn to scale.)



dynamics and competing urban demands that exert pressure upon form and determine the relative efficiency of function.

Dorney and Priddle (1973) and Coleman (1975) have given an outstanding demonstration in the Waterloo area of such an application of ecological concepts to the urban and urbanizing milieu. A study from this point of view of urban structures in Canada (and elsewhere) would reveal a number of patterns where the play of centripetal and centrifugal forces with and against natural features would stand out. Figure 3 makes an attempt to illustrate the variety of contacts, with reference to some Canadian urban settlements. What is the relative position of: a) the hard-core urban; b) the urban (residential-commercial); c) the industrial; d) the rural; e) the wild?

The **Toronto** type shows the hard-core urban occupation on the waterfront and the lack of any particular obstacles to urban and/or industrial expansion in the hinterland. (Similar examples: Trois-Rivières [Québec], Saint John [New Brunswick], and also Chicago, Zurich.)

The **Montreal** type straddles two islands (one of them bearing a mountain) and overlaps onto the south shore of the St. Lawrence. Waterway and mountain favour the persistence of wild areas, as enclaves or outliers. Otherwise the encroachment of urban on rural land encounters no natural inhibitions. (Similar examples: New York, Stockholm, Paris.)

The **Vancouver** type is constrained by sea and mountain, both of which retain essentially wild occupation. The rural land use is badly squeezed. (Similar examples: Dunedin [New Zealand], São Miguel [Azores], Naples.)

The **Winnipeg** type shows a river-oriented structuration, with hard-core urbanization forming a nucleus for an eventually more or less concentric development. (Similar examples: Regina, Edmonton, Saskatoon and also Budapest, Vienna, London.)

The **Gaspé** type somewhat resembles the Vancouver type, but lacks a hard-core, although it likewise shows a squeeze of the rural land use. (Similar examples: Ste-Agathe [Québec], Corner Brook [Newfoundland].)

The **Cap-aux-Meules** type is strictly hewn to a highway axis (Similar examples: Weyburn [Saskatchewan], Waterloo-Kitchener [Ontario].)

Figure 3 emphasizes pattern and contact only, since it is not drawn to scale. These are physiognomic casts showing over-all constraints and a greater or lesser variety of contacts. But if we now pose the question of polarization, it is the direction of growth

and the quality of impingement that will stand out. There is, of course, no lack of examples of gravity displacement in evolving cities. Thus Calgary and Ottawa, at first centered upon their railways, refocused around their rivers. The migration flow to the city (a *centripetal* force) and the exodus to the suburbs and to the rural areas (a *centrifugal* force) are differently poised and characteristically affect the very shape of urban development. Table VI is an attempt to list the forces that tend to construct and to destroy the urban environment. It is not enough to recognize inward and outward movements. The urban *problématique* consists in distinguishing between the positive and negative in each case. For instance the flocking or rural-born and -bred people to the cities is the effect of professional and cultural opportunity not available in the country (a positive centripetal force), whereas it is also caused by the failure of agriculture, by expropriation, and by other adversities in the rural milieu (all negative centripetal forces).

Table IV is very tentative, but a tallying of this kind would permit the development of a grid that would show contrasts in the positive/negative drawing forces in the concentration of populations in towns and the trophic level at which they operate. The patterning thus obtained would be useful to the definition of urban/non-urban strategy and would meet the following issues.

- a) How much urban development has occurred on high-grade (categories 1 and 2) agricultural land?
- b) What is the motivation of city-dwellers in acquiring a second home in a rural or wild area?
- c) What is the true residential preference of suburbanites?
- d) How could land-banks be circumscribed and how would legislation deal with speculators?
- e) What is the real state of air and water pollution and how is it perceived?

Level	Resource	Quality	In the City		In Rural Areas	
			Centripetal	Centrifugal	Centripetal	Centrifugal
VI Control	Government	Central Provincial Local	*		*	*
	Finance	International Central Provincial Local	*		*	*
V Invest- ment	Recreation, culture	Diversified Poor	*	*	*	*
	Education	Full Partial Poor	*	*	*	*
	Work	Diversified Available Rare	*	*	*	*
	Housing & services	Abundant Accessible Diverse	*		*	
		Rare Expensive Cheap	*	*	*	*
III-IV Animals	Food	Varied Poor Cheap Expensive	*	*	*	*
	Traction	Numerous Rare			*	*
	Pets	Numerous Rare	*	*	*	*
II Plants	Food	Varied Poor Cheap Expensive	*	*	*	*
	Ornament	Abundant Rare	*	*	*	*
I Mineral	Soil	Hard Soft Wet Dry Fertile Poor	*	*	*	*
	Water	Open Channelled Pure Polluted	*	*	*	*
	Air	Pure Polluted	*	*	*	*

**Table VI.** Centrifugal and centripetal forces that tend to draw human population towards the city or towards the rural areas. (This table must be read from the bottom upwards, in accordance with the scheme of Figure 2.)

## **Urban structure, growth, and size**

The five questions just posed can be made to converge upon the matter of structure, growth, and size. Toronto, Montréal and Vancouver all demonstrate the tendencies that dominate urban development in Canada and that will continue to do so in the foreseeable future.

- a) Structure will consist of a (night/day – weekday/weekend) pulsating core; and an amoebic urban tissue encroaching upon rural land in an ecologically disruptive way.
- b) Growth will follow the uncoordinated investments of private enterprise with no consideration for harmony.
- c) Size, while not unpredictable, is really no part of planning.

Servicing networks and schedules, should one compare Canadian cities with Stockholm or Copenhagen, are hopelessly empirical and lacking in foresight. This is due in large part to the land-tenure system, and especially to the reluctance of Canadian municipalities to use their powers of expropriation and constraint (see Science Council Report No. 14, 1971, Recommendation No. 6).

The notion of growth was borrowed from the biological sciences and it sorely needs to be corrected by the notion of differentiation, also to be borrowed from the biological sciences. The metabolism of many cities (to pursue the analogy) is cancerous, inasmuch as quantitative addition shows no connection with diversification of functions. The development of a great variety of structures and services (in housing, transport, commerce, recreation, education) in a city is more promising of availability and of self-sufficiency than specialized (not to say uncontrolled) expansion of already successful ones. The benefits that will accrue both from thrift and from recycling have been mentioned earlier in the context of the limits to growth, and I need not develop this theme again, although I am bound to weave it into all parts of the Canadian environmental crisis.

As to size, even if we accept as inevitable Doxiadis' (1968) projection of an ecumenopolis that binds the whole planet into a tightening network with increasingly broad threads and large nodes, and if we accept the prediction that by the year 2000 virtually the whole population of Canada will live in cities, we

need not consider it negative in itself. We are bound to recognize, in the first place, that there is a lower size limit (both as to space occupied and as to number of inhabitants) below which certain advantages (commercial, social, cultural, political) are simply not to be had (choice of clothes, equipment, food, theatre, music, dance, education, political participation). The isolation, poverty and vulnerability of small communities (except for few individuals with minority requirements) are hardly acceptable to modern populations. Cities like Whitehorse, Yellowknife, Thompson and Sept-Iles, in the modern perspective, have barely crossed such a threshold. At the other end of the spectrum, the inhumanity of Tokyo, New York, or London need not be ascribed primarily to size, but more likely to structure and administration. Even more evidently the uncontrolled economic and demographic forces that bear upon Calcutta and Ibadan are responsible for the prevalence of slums, poverty, death and disease. Blumenfeld (1949, 1969) has repeatedly warned us of the false problem posed by size in its purely quantitative aspect. We are bound to believe that the highest quality of life is compatible with large cities.

## Housing

A study of the metabolism of towns is inseparable from an inquiry into the housing stock.

From an ecological point of view, one of the first things that comes to mind is the nature of building materials. From this point of view Canadian cities (and even farmhouses) built before 1900 owe a great deal to the landscape or, at least, to the geographical region which they occupy: stone, brick, mortar, wood, shingle (and even metal and glass) are derived from local resources. Although these very resources may still be available, contemporary houses throughout Canada are constructed with materials imported from central locations and often from great distances. Regional specialization and high industrial efficiency have promoted inter-regional exchange to the highest degree. This flow of building materials, accompanied by the acceptance of standardized architectural patterns, has tended to destroy any particular fitness or harmony of building and landscape. The "mobile home" is the final "all-purpose" structure that belongs nowhere that has no proper ecological niche.

Cityscapes at all times have shown evidence of historical addition, super-imposition and succession. A single building, like the cathedral of Chartres, bears witness to the style of several centuries. The present variety of a city as a whole, and of its component neighbourhoods, is thus due to the structure and function

of built-up masses. Entire quarters are homogeneous in height, breadth, size, texture, etc., and also belong to the same period. Some of the most attractive European cities (in England, Holland, Germany, France) display their history, ward by ward, street by street, in the form of buildings without necessary loss of functionality. Fragments of such a pageant are visible in Victoria, Québec, Old Montréal, Fredericton, St. John's, etc. Gowans (1966) has defined and illustrated Canada's history through architecture admirably well. But mostly the juxtaposition of masses suggests a shock of forms and functions where architectural recall clashes with textural anarchy and functional confusion. The resulting non-environment induces recoil and evasion, makes anything like personal identification unlikely and unreal. Of such depersonalized and unaesthetic neighbourhoods, Gertrude Stein said: "There is no there there..."

This unreadable writer's aphorisms are always best unfolded by other people, her "there" is the "sticks and stones" of Lewis Mumford (1924), the mud, granite and tile of Orlando Ribeiro (1961). What makes a house a home? Functionality and continuity. The human habitat, *sensu stricto*, or abode, or dwelling-place, should meet the following requirements:

- a) **Space** enough to insure privacy and conviviality to all its occupants.
- b) **Peace**, or freedom from noise, unsightliness, intrusion and other nuisances.
- c) **Comfort**, or protection from excessive heat/cold, light/darkness, humidity/drought; adequate sanitation.
- d) **Amenities** in decoration, surroundings, storage, conservation, repair and display of possessions.
- e) **Expression of individuality** in design and decoration.
- f) **Neighbourhood integration**, or relative similarity of housing and habits combined with congenial variety of access to services.

Such are the functions of the individual's (or the family's) habitat. Continuity of occupation and psychological identity are ensured by familiar objects having significance for the inhabitants: fence, tree, door, furniture, books, furnishings, art works. The identity of the individual is bolstered by the presence of chosen objects that trigger the memory and that link past experiences with present being.

Marcel Breuer (1974) put it very well by saying that "the demand that the building, the street, the square, the city, the road over the land — indeed the whole manmade world, including low-cost housing — speak of a mental surplus, of a conceptual generosity; of a stance which is optimistic and as creative as a child's attention."

I have attempted elsewhere (Dansereau 1971b) to provide an ecological definition of personal fulfillment by an enquiry into the real needs of man, up from the physiological to the socio-cultural, and have proposed a grid that allows comparisons between populations. Deprivation of some of the benefits of modern living is shown to strike the rich as well as the poor. In that essay I have tried to highlight the conflicts involved in the sharing of the environmental pie, wherein need, right and fulfillment are so variously and so unjustly balanced.

In a private commentary (not a minority report) (Dansereau 1970) on the Hellyer Commission's Report (1969), I have addressed myself to the myths and realities of social need, in the following terms.

"Who must have television? A Cadillac? A single-family house? Panem et circenses, to be sure. It is both naive and unjust to deny a television set and a washing-machine to the poor mother of ten children. These commodities are not 'imaginary' needs.

"Without attempting to list the objects and facilities which an average Canadian family wishes to obtain for itself and does indeed acquire (often before it can truly 'afford' them), it is no unthinkable that a more austere or merely a more lucid society could tick off a number of amenities without which it can do very well indeed. In times of stress (e.g., in wartime England) or in areas where communication difficulties are still extant (e.g., New Zealand), or where a generally low income prevails in comparison to neighbouring countries (e.g., Portugal), a greater value is set upon rather ordinary items

(food, paper, vehicles) and thereby quickens the quality of life. This potentially Epicurean lesson may yet appeal to the affluent society. The seemingly negative hippie response, so intent upon its rejection of consumer goods, is a step in that direction.

"But there are a whole series of myths, of another kind, that are of more immediate pertinence to our present inquiry. For example, what is the basis of the widespread objection to high-rise buildings? Of the almost universal demand for single-family houses? Of the love for greenery? These and other prejudices are often ascribed to something called human nature, which 'cannot be changed.' This argument is, of course, redolent of much rightist righteousness (as is the grossly misinterpreted 'the poor will always be among you') that it is certainly incumbent upon the scientific mind to question.

"The history of our cities explains such attitudes abundantly, although it can provide no justification for their projection into the future. It is part of the rural heritage to consider home ownership and single-family dwelling as an ideal for all times and places. It is part of the adversity of low-income city dwellers to despise the inelegant, crowded, high-rise building. It is part of the middle-class urban tradition to respect greenery as a status symbol.

"But what of the truly urbanized, in those areas that have achieved grace of some kind? Are not some of the multiple-dwelling constructions — including some high-rise — among the most pleasant, safe, spacious, and livable places? Do not some combinations of terraced gardens (yes, ten stories above street level) overlooking a public park offer ideal alternatives of privacy and companionship?

"It seems to me that we should probe these attitudes much more than we have, and that we might do so systematically, in a spirit of enquiry, not criticism. There undoubtedly remains a great deal to be horrified about in our cities; and the 'good' examples hinted at above are very expensive and within reach of only the privileged few.

"The thinking, working and living habits of city-dwellers in Canada vary enormously from coast to coast. The persistence of a rural frame of mind is nevertheless a strong undercurrent. It seems very difficult to recognize a truly urban mentality in Charlottetown, Saskatoon or Edmonton, not to mention Baie Comeau or Yellowknife. And for the matter of that, Montréal and Toronto harbour countless nostalgic rurals.

"There would be a great deal of evidence (from Paris, London, Budapest, New York and even Montréal and Toronto) to vouch for the acceptance of (not necessarily the resignation to) multiple-family dwellings, row-housing, and other aspects of city life. The present pattern of family migration is frequently as follows: young, as yet childless, couple in city apartment; young family in suburb; more mature family, with children, in more spacious suburb; aging, now childless, couple in city apartment. This behaviour is constrained by the present pattern of economic conditions and educational opportunity. But the lack of good schools and decent-sized, economically accessible, and safe apartments or houses in the city is not inherent to higher density of population and the escape to the suburb is largely negative.

"Without following any further, and step-by-step, the vagaries of the Canadian family, it is possible to detect many phases in its life-history where choices are made for less than obvious reasons and where alternatives exist or could very well be worked out if they were known and desired by the interested parties, and were made more nearly possible by a redesigned national economy and a more adjustable local legislation."

Nowhere do we find a clearer instance of the ecological impact of a psychological pressure. I have argued this point at some length in my proposal of the six-layered scheme pictured in Figure 2 and used as an infrastructure for the ecological study of the new Montréal airport (Dansereau 1970, 1971, 1976). The refusal by certain human populations to consume a certain kind of food (pork, beef, mutton), to use certain building materials (wood, plastic, aluminium), to ride certain vehicles (horses, bicycles, trains, buses, planes), to partake in certain community activities (beer-gardens, taverns, fairs, open-air concerts), and finally to inhabit certain dwellings (cabins, high-rise buildings) or neighbourhoods (slum area, city-centre, suburb, village, wild

land) all exert the same kind of leverage on landscape and on its management as earthquakes, floods, aridity of soil, weed or pest invasion, and other long-recognized "natural" ecological factors. Which amounts to saying that the psycho-social determinants of the ecology of housing are easily as weighty as the carrying capacity of land, the soundness of building materials and practices.

Just how well are Canadians, especially urban Canadians, housed as far as the five criteria mentioned above are concerned? What is the range, what is the average in the (A) wild, (B) rural, (C) industrial, (D) urban areas?

- A. Canadian hunting and fishing populations (mostly Indian and Inuit) are reasonably well off, it would seem, in this respect, with benefit of nylon tents, portable stoves, etc.
- B. Rural houses may be getting uglier with each succeeding generation but are increasingly provided with comfort and consumer goods.
- C. Typically industrial settlements (of the company-town type) are uniform and monotonous, to be sure, but very comfortable and generally fairly spacious.
- D. Urban dwellings show the largest range (from the mansion to the hovel) and reveal the most acute crisis.

It would not be fitting, in an environmental review, to attempt a rehearsal and summary of the Hellyer (1969), Lithwick (1970) and Science Council of Canada (1971) reports on the predicaments of housing in Canada. But utilization (and non-utilization) of land is so obviously controlled by socio-economic factors that affect housing that they must at least be enumerated.

- a) **Speculation** maintains land in an unproductive state while its value increases through public and private investments.
- b) **Zoning laws** are often obsolete and out-of step with present requirements and inhibit diversity.

- c) Building is a non-industry, since it is uncoordinated, suffers from undue restrictions (e.g., taxes) on the one hand and lack of planning on the other.
- d) Residential development is completely dictated by economic and not social benefit.
- e) Urban renewal has, by and large, been preferred to urban restoration.
- f) Taxation policy, by and large, diverts land to higher density use.

The real-estate lobby, municipal bureaucracy, supply and labour troubles, acceptance of the economic imperative, and indifference to history all combine to allow the disruption of neighbourhoods, the uprooting of communities, the hiltonization of cityscape (witness Québec City) and the continued prevalence of short-term policies for long-term investments.

## Transport

Some of the greatest adversities suffered by the urban population are to be encountered on the transport circuit. The nervous stress of solitary commuters driving over-powerful and wasteful vehicles at alternating high speeds and bumper-to-bumper jerking halts, presents a staggering expenditure of unproductive human effort. Harmful levels of chemical pollution and of noise are reached inside the city limits. This is not to say that public transport is free of such stresses in its present form. Damage to vegetation and to what is left of wildlife (and to human life) is thus rampant and is increased in snowy Canada by the widespread use of brutal snow-removal machinery and its accompaniment of corrosive salt.

The work-residence-recreation movements, daily and yearly, on the intra- and inter-city networks are badly scheduled and unaccompanied by the kind of relief which various forms of public or collective transport would offer. The deterioration of the public-private ratio is counter-historical in creating ever-increasing deadlocks.

The crisis in transportation stems from the following causes:

- a) status attached to large, expensive cars;
- b) inadequacy of rapid ground and underground transit;
- c) absence of collective transport in suburbs;
- d) lack of residential facilities in densest working areas;
- e) too many vehicles and too much reliance on private transport;
- f) narrow range of working days and hours;
- g) increasing rate of noise and pollution;
- h) increasing cost of fuel.

The occasional (and for some commuters, frequent) nightmare of traffic jams epitomizes all of these features. (Julio Cortazar [1972] has written an oppressive little fable on this situation.)

## Planning and zoning

If zoning in Canadian cities is inadequate, obsolete and unduly coercive, this may well be a result of administrative shortsightedness, compliance with vested interests, and rigidity of application. It is also due to the fact that alternative options are unknown to citizens and neglected by planners, that the prevalent architectural and social trends go unchallenged and that the present economic order is assumed to be permanent. The perpetuation of legalized disorder and of institutionalized injustice is therefore the standard. It is simply not possible to consider either zoning or planning in a purely technical and scientific way without reference to the underlying values.

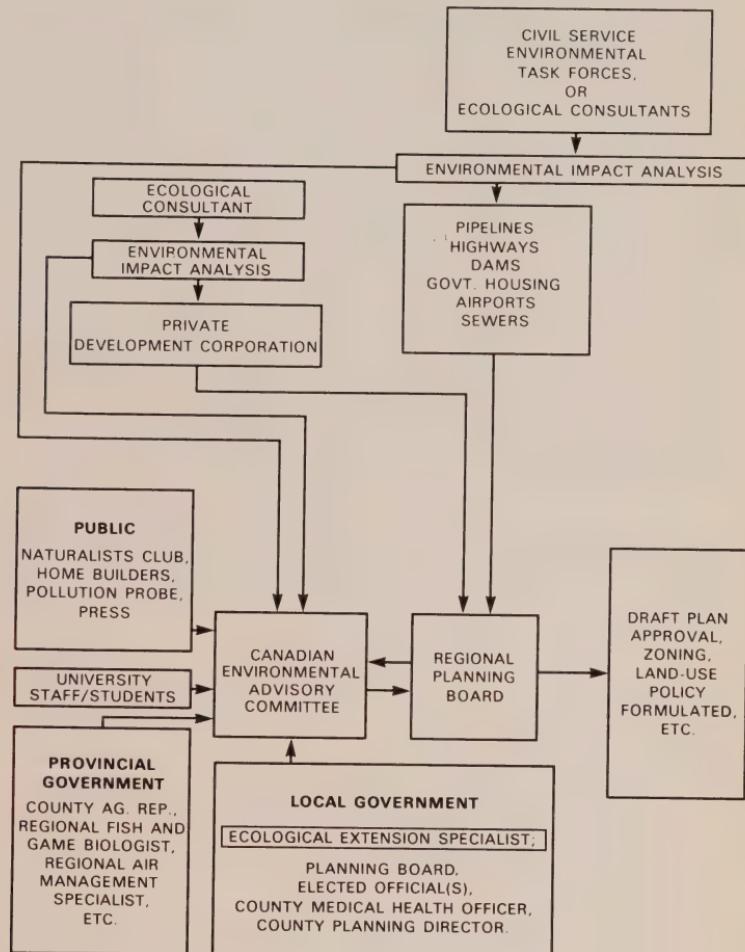
Ecology and eco-planning are not likely to redress the Canadian urban prospect. Nor do eco-planners start as nearly from scratch as some of them assume. From Park (1952) and Stapledon (1971) to McHarg (1969) and Dorney (1972, 1973), an emerging human ecology provides the mainsprings of ecological design. A submission of urban structures and functions to an ecological examination through the binoculars of natural and social science is our principal hope.

I have said enough on the ecological framework of analysis in earlier chapters not to repeat my plea for a *totalist* or global view as promised in Figure 2 and in Table I, and it is with an eye to this "ball-of-arrows" coordinate that I ask: "What factors, knowledge and skills are likely to meet the requirements of urban planning?"

Perhaps an orderly answer can be sought in an investigation and a correlation of the environmental forces lined up according to their trophic level, as follows.

- I. At the **minerotrophic** level: the regional displacement of air masses, their normal and acquired load of moisture and solid particles; the quality and quantity of water available, its natural and induced pattern of distribution; the relief, exposure, hardness and fertility of the solid substratum.
- II. At the **phytotrophic** level: the kind, variety and distribution of spontaneous flora and vegetation, the present and potential plant cover; the array of landscaping and ornament.
- III-IV At the **zootrophic** levels: the persistence and elimination of wild animals (insects, birds, mammals); the opportunities for domesticates and pets.
- V. At the **investment** level: design, construction and distribution of roads and other services; building of residential, commercial and other structures; preservation or elaboration of green spaces; storage and protection of imported vegetable and animal material; distribution of market supplies; police force and public information; recreational, educational, and cultural facilities.
- VI At the **control** level, municipal zoning legislation, ruling and enforcement; financing; government; religious institutions.

**Figure 4.** An organizational framework for environmentally guided land-use planning at the county or regional level. (Redrawn from Dorney 1972).



Competent planning will necessarily run through such a gamut. If it is ecologically slanted, it may well do so in the order indicated above. Dorney (1972, 1973) and his collaborators (Coleman and McNaughton 1971, Kitchen 1971, Coleman 1975) have provided very convincing evidence of the value of eco-planning. Figure 4 is a flow-diagram that illustrates a relay of decisions not unlike the one suggested in Figure 1. The presence of ecologists in virtually all phases of the planning and implementation is the best possible guarantee of environmental protection and ecological management.

This necessarily evokes the broader question of environmental assessment which should be geared to the A-B-C-D balance at all events. Fischer and Davies (1973) have just reviewed this topic very capably, covering the ground since the Leopold *et al.* (1971) matrix was proposed as a new starting point. (See also Marsan *et al.* 1973, Lapoix 1974 and Dansereau 1976). I shall not make any further comment on this topic since McTaggart-Cowan's CEAC report (1974) is available, and since the CEAC has issued a policy paper (Report No. 1, 1974).

The principal questions that pose themselves to Canadian urban planners can be grouped under the following headings.

- a) **Salvage operations.** Revitalization of roads, spaces and buildings whose function had lapsed or diminished (railroad tracks, empty lots, churches, warehouses).
- b) **Renovation processes.** Destruction of slums, warehouses, commercial blocks or unsanitary, unsafe, unattractive and non-significant buildings to be replaced by more functional ones.
- c) **Growth control.** Patterning and zoning of all intended development and re-patterning of already obsolete or undesirable servicing media.
- d) **Transport and circulation flow.** Timing of traffic on existing throughways and re-allocation of walking and driving areas; of private and public vehicle use.
- e) **Spacing and accessibility of amenities.** Ratio of green spaces and other recreational spots to area and population.

The environmental issues under each of these items are very numerous. The principle of continuity mentioned above militates very strongly against the destruction of churches whose congregations have dwindled, old railroad stations that cater to reduced traffic (or none at all), ornate Victorian houses with wastefully monumental staircases, etc. One may well turn to Moscow and Leningrad where some such buildings are turned into museums, and others have been dedicated to a new function (library, swimming pool, community centre), although admittedly without much grace. The citizens of a town that forces them to live only in the present and with no reminders of their history (yes, even jails, slavery, colonialism, capitalism . . .) are very impoverished indeed! The will to obliterate symbols of retrospectively hateful episodes can go a long way; many Brazilians dislike their most beautiful tree, the royal palm, once the ornament of slave-operated fazendas; some fanatics in our own country would stamp out gabled mansions reminiscent of Victorian puritanism or English colonialism, etc.

Renovation is justified mainly where a new dedication does not destroy a heritage which is capable of salvage and active use.

In fact, an urban planner's programme is geared to all six items under review in this chapter.

## Amenities and recreation

Ever since Kevin Lynch's (1960) *The Image of the City* and Jane Jacobs' (1961) *The Death and Life of Great American Cities* were published, students of cities have attached much importance to perception of environment. Saarinen's (1969) reassumption of the subject, Platt's (1970) penetrating essays and Lowenthal's researches (Lowenthal 1972a, b, 1975, Lowenthal and Riel 1972a, b) all bear witness to the regional and social diversity of the inner reflection that precedes the projected wish and the move to its implementation. I have myself argued at some length (Dansereau 1969, 1973b) that the inscape is a template for the landscape in the mind of all those who alter its management, from the wild hunter and the farmer to the industrialist and the architect.

Perhaps I should start by saying that the six requirements under Housing (space, peace, comfort, amenities, expression of individuality, and neighbourhood integration) constitute a lower threshold and that some reality of fulfillment is obtained only if an additional surplus is available.

The meaning or rather the meanings of "amenity" and "recreation" are to some extent elusive, as is the notion of beauty (see Morse 1975), but even within the compass of a shifting

definition it is not impossible to delineate the problems. Maybe the leading questions boil down to the following.

- a) How is **diversity of choice** to be assured with respect to housing, transport, education, recreation and other forms of sharing in the collective benefits?
- b) What mechanisms do we have for offering **real alternatives** and for quantifying the trade-offs?
- c) How do we measure **efficiency** or productivity at work, and **value of service** rendered?
- d) What is the final measure of health (physical and mental) and of **community fitness**?
- e) What is really “**tolerable**” in a polluted environment and what price can a city ultimately pay for cleanliness?
- f) In what way do we really need **green spaces**?
- g) How can we assure a reasonable **balance** (although a shifting one) of privacy/togetherness (architecturally, socially, environmentally)?
- h) What are the most satisfactory ways of ensuring **consultation** and also **efficiency of decision-making**?

None of these questions are environmental in a strict sense. They are social and psychological and of course economic. But different answers have different ecological consequences.

Maybe the most specifically ecological is the presence/absence or rarity/abundance of wild species. It is unquestionable that the earliest role assigned to ecologists, if they were consulted at all by planners or developers, was the investigation of wildflowers and birds (some developers would dearly like to confine ecologists to the bird-flower level. “Cordonnier, pas plus haut que la chaussure”.) In fact, ecologists, trained in the natural sciences, are uniquely competent in this field and must continue to emphasize its relevance to the health of the city and to all of the contemplated uses of the land. The eco-planners (see Figure 4) are insistent upon this (McHarg 1969, Dorney 1972, Kitchen 1971, Dansereau 1976).

A preoccupation with weeds and pests is far from new, although urban biology is to this day a poorly attended subject. One would have thought that Fitter's (1945) *London's Natural History* would have set off a current of such endeavours. Actually, in Canada, we have Cléonique-Joseph's (1936) pioneer study on spontaneous vegetation of the streets of Montréal; in France, Jovet's (1954) urban flora and Bournérias' (1968) suburban vegetation. In Japan, Numata's (1973) symposium on *Fundamental Studies in the Characteristics of Urban Ecosystems* is strongly slanted to natural history, although it contains important contributions on demography and on the chemistry of pollution.

An extremely useful investigation is the study of the abundance of species of mosses and lichens in urban areas. Lichens are highly sensitive to pollution. It was Nylander who first observed this phenomenon in 1866 in Paris. But it is only recently that maps have been drawn, in Belgium (DeSloover 1964), in Japan (Kurokawa in Numata 1973), in Ireland (Fenton 1960), in Britain (Gilbert 1965, Hawksworth and Rose 1970) and in Scandinavia (Hangsja 1930, Hoeg 1936, Skye 1965), showing concentric zones of loss of lichen cover proportionate to the purity of the atmosphere. Canada has also resorted to this pollution index: LeBlanc and his collaborators (1966, 1970, 1972a, b, 1973a, b, 1974) have applied it to Sudbury, Wawa and Montréal. Granger (1972) has translated the data for Montréal into computer maps.

Green spaces is a topic in itself, for which a growing literature accounts. Clauzure's (1970) book and the multidisciplinary symposium held at the Holdsworth National Resources Centre (Little and Noyes 1971) make an effort to distinguish the biological (health-inducing) advantages from the amenities. Psychiatrists are coming into the picture with a most valuable contribution. Fortin and St-Jean (1976), applying Langner's (1962), Roen's (1966), and Burnes' (1966) methods, were able to map community adaptation in the new Montréal airport zone.

Research on the city and on urban problems has increased tremendously in Canada in recent years. But maybe the following questions could be emphasized.

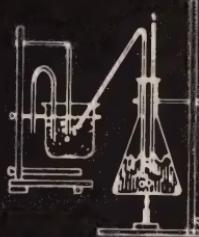
- a) What has been, in fact, the **succession** in land use from wild or rural to urban, in Canada?
- b) How irreversibly do the present **transportation networks** prevent a more diversified re-patterning of cities?
- c) How does **environmental perception** positively and negatively affect planning and development?
- d) Can **innovative architecture** contribute to improved quality of the urban environment?

**ASPIC**

AUSTERITY



SCIENCE



PLANNING



INFORMATION



CONSULTATION





## Chapter 5.Priorities: Operation ASPIC

This cursory scanning of Canada's landscape with a roving ecological eye reveals in the diverse environments a number of crises. In a world perspective, Canada is very fortunate indeed for it does not suffer from earthquakes like Costa Rica, from drought like the Sahelian lands, from erosion like Haiti, from hunger like India, from crowding like Japan. That is not to say that the Canadian environment is not menaced. I have been at pains to point out many deteriorations, some of them irreversible, that scar so many of our landscapes. Good management has not always prevailed, even less ecological wisdom.

Canada needs a **programme on environmental management**. It may well be the Canadian Environmental Advisory Council's primary vocation to submit such a programme. The questions defined, considered and investigated by the Council have spread across a wide frame, essentially covering the questions outlined above. I shall not presume to recommend such a programme but I will try to abstract from the foregoing survey what seem to me the inescapable focal points: **austerity, science, planning, information and consultation** (the ASPIC programme?). Under each of these headings we may be able to gather the threads of sound **principles** (blue) to test the issues (yellow) that have arisen in the face of various **crises** (red) and through study and **research** (green) to reach **solutions** (purple) that will allow better use of our resources.

The requisites of valid solutions, therefore, are:

**Austerity**, which requires a heightened consciousness of our whole environment and a willingness to spare and to re-use.

**Science**, as the indispensable tool of investigation and research which will provide a true image of our ecosystems prior to decisions concerning their exploitation.

**Planning**, derived from moral, political, social and scientific tests of the technically, economically and ecologically allowable choices.

**Information**, to be obtained in full freedom and disseminated at various levels.

**Consultation**, which is of the essence if the people potentially affected by a decision concerning their environment are to participate; and, at the other end of the scale, if workable international agreements are going to be enacted.

The gearing of problem-solving to the ASPIC framework can be exemplified by selecting the six following issues as deserving high priority:

1. The A-B-C-D balance, national and regional.
2. Rationalization of park distribution.
3. Regrouping of agricultural economies.
4. Restraint of long-range industrial investments.
5. Revitalizing of cities.
6. Shifting way-of-life.

### **The A-B-C-D Balance, National and Regional**

A tightening rein on land use is indicated by the growing pre-occupation of Canadian governments with foreign ownership, at a time when ownership allows a freedom of use and disposal which is being more and more restricted. No less than Portugal or Mexico, Canada is bound to enact more land-use legislation.

Foreign-owned firms have been very stringently set back in the field of telecommunications by the Canadian Radio Television Commission, which has also regulated the percentage of "Canadian content" in the programming. This vividly perceived threat to information and culture is paralleled by the economic force from which it originates. We cannot be quite reassured by the Safarian report (1969) on behalf of the bonne-ententist Canadian-American Committee.

I suggest, however, that a mere stiffening of our defenses is not good enough if all we have in mind is to save our lands and resources for our own use, "just in case we ever need them." What we want is a bold design of land-use with regional pattern-

ing of wild-rural-industrial-urban occupation. The reasons for doing this are the following.

- a) No counter-vocational development should be allowed, e.g., lumbering or ploughing on unsuitable and unpromising sites.
- b) Optimum-size areas of reasonable accessibility should be saved for study and recreation (see Section 2, below, and Chapter 4.A.)
- c) Both for purposes of feeding the people of Canada and keeping open the option of rural life, land-banks and agricultural communities should have precedence, in certain areas, over other land uses (see below, and Chapter 4.B.).
- d) Industrial development should be redesigned with greater respect for indigenous resource bases, and integrated more harmoniously into rural or urban tissues (see Section 4, below, and Chapter 4.C.).
- e) Cities should become less hazardous places to live in, and their opportunities and amenities should be better geared to spatial and occupational patterns (see Section 5, below, and Chapter 4.D.).
- f) In order to achieve the above, a national plan for the total environment is called for, based upon the approaches now used separately for urban development and for agriculture.

The ASPIC formula for implementing these principles requires: A) a willingness and awareness which are not too widespread; S) knowledge which is scattered, and more knowledge which we do not have; P) models or plans, which we do have, and which can be enlarged to the whole of the national scene; I) widespread airing of the A-B-C-D situation by full use of audio-visual media; C) a great deal of information: campfire, grassroots, barroom and sidewalk consultation and feedback from regional and local initiatives. Certainly some mechanism is needed to check the ultimate effectiveness of consultation.

To this end: a new federal Commission? Council? Possibly a job for the CEAC?

### Rationalization of Park and Wilderness Distribution

There are not enough parks in Canada, they are not well studied, they could be used more rationally. Chapter 4. A has considered these questions. The outstanding demands for solutions are the following.

- a) **Scientific studies** (geology, geomorphology, flora and vegetation study, zoology and wildlife) and mapping should be undertaken according to a uniform methodology in all parks.
- b) **New parks** should be created, especially in natural bioclimatic and/or physiographic zones where there are none.
- c) The **national park laws** and regulations should be reviewed in the light of contemporary principles of human ecology.
- d) **Socio-psychological inquiries** on park and wilderness use should give us a table of movement, pressure, motivation and demands of the Canadian population. It could well be paralleled by an education campaign to diffuse knowledge of natural history.
- e) The **Federal-Provincial Parks Association** should be strengthened and should consider year-round operations; the federal and provincial environmental advisory councils should make a special study of park distribution, status and use.
- f) **Municipal and local conservation groups** should be encouraged to set up preserves and conservation areas.
- g) **Universities and museums** should resume their almost forgotten role in ecological research and many of them could well own and operate study areas.

**h) Wilderness areas** in the provinces as well as in the Northwest Territories should be studied and classified soon for the triple purpose of compatible and incompatible livelihood, recreation and conservation.

The lesser development of the north, on the one hand, exposes it to the threat of irreversible spoilage, while the greater development of the south, on the other hand, places a high cost on the preservation of a full gamut of natural areas (as noted in Chapter 4.A). Knowledge of northern ecology is sadly lacking, as witness the dismay of scientists involved in the prediction of ecological damage in James Bay and in the Mackenzie Valley. The recent Mont-Gabriel conference on the north (Greenaway 1973) testifies amply to the fragmentary nature of our understanding of the arctic and subarctic. In planning to proceed with pipeline, mining, damming and other massive undertakings, we simply do not know how we should weight the necessary trade-offs. Hamelin has repeatedly pointed out (Morissette and Hamelin 1967) the inadequacy of "southern" planning and construction in the north. It turns out that Inuit and Indian are more amenable to change than European-Canadians.

The situation in the south is even more crucial, inasmuch as a good deal of environmental change is quite irreversible. An implementation of most of the items mentioned above would create the indispensable social and educational climate for nature appreciation.

In fact, a nature-oriented society (not unlike the Scandinavian whose landscape is so similar to ours) would devise a number of new jobs for Canadians. I hope I may not seem too naive if I suggest that planting trees, digging ditches, recording bird and animal movements and migration and keeping phenological records would be more productive (at the same cost) than living idly on social welfare benefits! It is our very concept of man-in-nature that needs readjustment in many ways: more humility in our stewardship of all forms of life and more pride in our past achievements. This latter feeling calls for a shift in our park policies so that the stamp of fishing, agriculture and lumbering be not ruthlessly erased from protected areas.

Canada is strong enough not to surrender utterly to international constraints. The test of relative autarky in petroleum products is the latest proof of our gamble against geography. Many years ago André Siegfried (1937) described Canada's unique geo-historical drama.

The play of market demands versus the desirability of land occupation and use has varied a good deal since the massive exports of wheat first gave Canada a prominent place on the international agricultural chessboard.

The pressures from within to open up our frontiers are, of course, alternately in accord and in discord with demands from outside. The truth is that many farming communities are privileged, at this time, in terms of subsidized supplies, production and marketing. (One may note, in passing, that the income tax has not hit the farmers yet, as it recently has the medical profession and as it is bound to do if the claims of the farmers' unions to parity with industrial labour are honoured.) We have long devised political and economic mechanisms that favour agricultural operations. The question now is: how can these and similar devices be geared to a better ordained national plan for a long-term rural economy? The Canadian Council on Rural and Urban Development (1970) has proposed a national plan, but it is difficult to make out to whom it is addressed.

I use the term rural advisedly, rather than agricultural. I have in mind, to be sure, *a more rational and efficient agricultural productivity* as the mainstay of the rural landscape. But I also look to the growing importance of rural settlement as a result of many visible factors, such as:

- a) the increase of leisure time;
- b) the greater desire for contact with nature;
- c) the resurging habit of self-reliance;
- d) the craving for neighbourhood.

Some of these features are triggered by the inhumanity or the boredom of city living (which we are also bound to counteract; see Chapter 4.D and below); but they have a positive attraction of their own and (no matter how much cities are improved) they sustain a major option.

Individualistic, struggling, family farms are almost a thing of the past. The kolkhoz, the kibbutz and the commune stand out as models that can be severed from their corresponding political ideologies, in that they contain elements of economic and environmental wisdom and workability. It is hardly necessary to overthrow the capitalist system in order to re-pattern the rural landscape. For instance, at Mirabel (the new Montréal international airport zone) the French colonial cadastral divisions have been squarely re-patterned over some 95,000 acres, the better to develop farming in harmony with woodlands and recreation.

Even though the Lands Directorate of the Department of the Environment has entirely mapped the inhabited areas (land-use inventory and land-use potentials for agriculture, forestry, wildlife and recreation), our plotting of competing land-uses is not all that advanced; nor is our will to maintain a high degree of self-sufficiency in agricultural products. As to our desire to keep widely open the option of the rural way-of-life, it is even less certain. Adding to this the autonomist leanings in certain areas, the drafting of a rural economy with precise spatial assignments is one of our most difficult tasks. Our knowledge of market conditions is now highly sophisticated, and we should be in a position to make realistic decisions in view of a changing value system.

## **Restraint of Long-range industrial investments**

In virtue of the limits-to-growth hypothesis (Meadows 1972, Mesarovic and Pestel 1974), a certain number of issues arise to which answers can reasonably be given only if we can visualize and accept the consequences of the considered alternatives.

These issues are:

- a) The present rate of growth of industry is exhaustive of national and imported resources.
- b) The present consumption of industrial products is badly distributed and much in excess of the needs of the middle and upper classes.
- c) The rewards of the industrial processes to the successive investors and operators are often disproportionate and some of the marketing operations are unproductive and wasteful.

- d) There is little inter-industrial circulation, exchange and recycling or re-use of by-products and waste.
- e) Industrial operations of all four blocks (see Table III) are not geared to landscape planning.
- f) The burden of research is very unevenly shouldered by the various industries.
- g) Government and society themselves do not have a clear view of the rights of ownership where public utilities are concerned.

I recognize that I am out of my depth as an ecologist in bringing up some of these issues. I fully realize that they are economic and political. Being no scholar in political science and sociology, I nevertheless claim, as an ecologist, that all of the seven aspects of industry in Canada envisaged above are somehow visible on the face of the land and must be considered in a resource management plan. In that capacity and also as a scientist not untouched by historical knowledge I may well challenge the expenditures on national defence made by the federal government and the astounding sums of money wasted privately in advertising. Surely both these sectors of the Canadian economy lend themselves to a drastic cutting down.

If I cannot design a blueprint for solutions to this series of problems, I can attempt to offer some elements as follows.

- a) The slowing down of industrial production means a reduction of consumption, a possible partial return to artisanal techniques, a cut-down on imports, none of which are compatible with the dominant socio-economic trends.
- b) Market analyses made comprehensible for the general public, curbs on mendacious and insinuating advertisements, public discussion of consumers' interests, encouragement of cooperatives would reveal more clearly the true needs of the Canadian population.

- c) A thorough examination of all intermediate and non-productive operations would stimulate self-reliance and productivity of the individual buyer and gradual elimination of parasitic enterprises, among them the costly credit system.
- d) The whole process of recycling cannot be handled by voluntary associations; it has to be part of public policy, especially municipal, although industry's cooperation is indispensable and an industrial consortium could go a long way towards saving valuable resources.
- e) Municipal authorities are principally responsible for industrial location, protection against pollution and unsightliness. If they made use of their planning and zoning powers, a more livable landscape would emerge.
- f) Governments in Canada, at this time, waver a good deal in carrying out their own projects or in farming out research operations to private consultants, industry and the universities. A tightening of the over-all environmental investigation programme and a better coordination of the tasks and distribution of the expenditures is an urgent task.
- g) The profoundly altered status of private/public property and private/public responsibility is not clearly perceived in our free-enterprise society and there is little readiness to gear ownership and legislation to present realities. A fuller exercise of expropriation or joint-ownership rights by public bodies looks like a prerequisite for certain much-needed reforms.

Above all, a national industrial plan is essential. The oil crisis of 1973-74 has revealed how fully the conflicting economic and regional forces come into play when such problems are raised. The Commonwealth Conference of 1975 has cast bauxite, sugar, cotton and other cheap raw materials in the same mold. We can afford to face these challenges. We cannot let existing pressures operate without questioning their long-range conformity with national goals and distributive justice. Such issues must be clearly defined.

Attempting to bring such a plan (P) in line with ASPIC, it should include: A) a shift towards a more modest way-of-life; less consumption; S) an objective study of real physiological (health) and psychological (social) needs and of more economic techniques; I) a great wave of diffusion of industrial facts to nourish public and private discussion; C) tribunes and group-discussions involving segments of the population affected by industry, either as consumers or as producers or participants in industrial processes.

## Revitalizing of Cities

It is possible to discuss whether cities should be allowed to grow indefinitely, whether there is anything like an optimum size and whether "new towns" offer a better prospect than satellite towns (see Chapter 4.A). But above all, the following crises should be met head-on.

- a) **Low-rental housing** is unavailable, unacceptable or marked with a social stigma.
- b) **Circulation and parking** are nerve-racking, noisy, dirty, expensive, wasteful and tend to deface the urban landscape.
- c) **Green areas** are too few, too small, often poorly equipped and managed.
- d) The **city core** is emptied of all residential facilities.
- e) **Speculation** ties up property without providing public revenue proportionate to increases in value due to other public and private investments.
- f) **Arable and recreational lands** are encroached upon without regard for future needs of the city itself, of the province, of the country.

These six crises are all so obviously interdependent that it stands to reason that they cannot be tackled separately as they so often have been. The Ministry of State for Urban Affairs has a research branch where this question is being considered. Meanwhile, and for many years now, the Central Mortgage and Housing Corporation has served, partly because of its granting

capacity, as a sort of regulator of urban design. Need it be said that this is not good enough?

I can only go full cycle, back to the opening statements of this essay: we cannot manage our Canadian environment safely, sanely and humanely unless our social and moral priorities are moved from the prevalence of economic growth to the betterment of the quality of life. This requires the adoption of a different sequence in decision-making, something like the lower block of Figure 1.

Such a shift would imply obedience to the following principles (which I am listing in ASPIC order).

- A More self-reliance of the individual and of the household unit (whether or not a family) will lead to greater enjoyment in the satisfaction of food, shelter and working needs through production or construction of a larger part of products, artefacts and services.
- S A heightened consciousness of the identity and capacity of living and non-living objects in the environment can be attained through study, research and discussion, and through greater opportunity for contact.
- P The necessity of more order in daily life will lead to a great variety of plans on a short-term basis for the household unit, but on a long-term basis for the community and even longer-term for the country as a whole.
- I Reading, listening, viewing and discussing will provide real knowledge concerning the opportunities and constraints of the environment, from the narrow circle of the community to the planetary prospect.
- C Decisions can become less arbitrary and more satisfying if they are made jointly with others of similar condition who likewise accept their consequences.

Again, I feel that the issues raised by the application of these life-saving principles are knotted in the planning process and I make no apology for the utopian cast of these five principles.

Their adoption and application rests upon the faith one has in Canada — or is it in Man? Optimism is always more visceral or

hormonal than rational, to be sure, but I hope I have drawn in the foregoing pages a number of inscapes as well as landscapes that indicate a profound need for change.

The Canadian Environmental Advisory Council may be primarily an organism designed to provide a lucid analysis of the state of the environment in Canada today. It also aspires to indicate solutions to our national and regional problems. Other reports, now being issued, are much more specific than the present overview and many such reports will continue to implement the role of the CEAC in the planning of environmental control.

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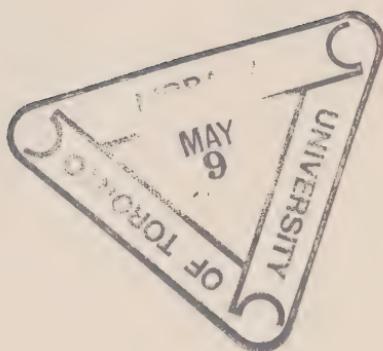
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